

Miles Joseph Berkeley's *Hypocrea*

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ABSTRACT—The Rev. Miles J. Berkeley was active in Britain in the middle of the 19th Century. Among his many scientific endeavors was the study of fungi and plant pathology. Between 1842 and 1892 he published, alone or with collaborators CE Broome, MA Curtis, MC Cooke and JB Ellis and BM Everhart, fifty-six new species of *Hypocrea* and he recombined into *Hypocrea* two additional species. These are foundational species in the genus *Hypocrea*, now *Trichoderma*. Types of all names that Berkeley included in *Hypocrea* have been examined for this study. The disposition of those names is discussed. The following new combinations are proposed: *Amplistroma cervinum*, *Ascopolyporus maculiformis*, *Stilbocrea neilgherriensis*, *Trichoderma deplanatum*, *T. discellum*, *T. grossum*, *T. laetioris*, *T. maculiforme*, *T. multiforme*, *T. petersii*, *T. rugulosum*, *T. saccharinum*, *T. scutellaeforme*, *T. subrufum*. Lectotypes are selected and or designated for *Hypocrea farinosa*, *H. laetior*, *H. maculiformis*, *H. multiformis*, *H. neilgherriensis*, *H. ochroleuca*, *H. pezizoides*, *H. ravenelii*, *H. saccharina*, *H. scuellaeformis*, and *H. subrufa*.

KEY WORDS—*Hypocreales*, nomenclature, taxonomy, *Trichoderma*

Introduction

Epic voyages from Europe at the very end of the 15th Century, e.g. Columbus west to the New World in 1492 and da Gama east to India by way of the Cape of Good Hope in 1497–98, opened an age of global connectedness and exploration. European Empires of England, The Netherlands, France, Portugal, and Spain spanned much of the globe, and British, Dutch and French explorers, adventurers and missionaries were sending curiosities – collections and cultural artifacts – to their mother countries. Late in the 18th

Century Empiricism – experience and experimentation – began to replace Rationalism in Science. In 19th Century Britain natural philosophers such as the polymath William Whewell and Charles Babbage; as well as Alexander von Humboldt in Germany, and Jean-Baptiste Lamarck in France, working alone in their home laboratories, gardens, or observatories, were making discoveries in geology, mathematics, physics, medicine, zoology, and botany, leading to hot discussions in meetings of The Royal Society and other learned groups (Read about these amazing people in Snyder, 2011 and the biography of Alexander von Humboldt by Andrea Wulf, 2015). New discoveries in geology and biology lead to a spreading belief that the Earth and life on it is an ongoing process rather than the result of a single creation event, a discussion that roiled scientists in association meetings well before Darwin published his *Origin of Species* in 1859.

The Rev Miles Joseph Berkeley (1803–1889) was living and working in that exciting scientific milieu (Berkeley's life is reviewed in an undated and apparently no longer available contribution from the Eastern Penn Mushroomers: Dawson, John. Who's in a Name: ? *Bondarzewia berkeleyi*). In 1825 Berkeley graduated Christ's College, Cambridge. He was fifth senior optime, a mere second-class degree, but his friends thought that he could have attained higher honor had he devoted more time to studying and less time engaged in his many scientific researches (Druce 1892). That Berkeley had time to undertake scientific endeavours is difficult to understand, given that as a priest in the Church of England, he was successively curate of St. John's, Margate, perpetual curate of Apethorpe and Woodnewton, Northamptonshire, and, finally, vicar at Sibbertoft. His activities for the church aside, Berkeley found the time to father fifteen children. The pay from his official 'day job' as a cleric did not provide sufficient wherewithal to support the fifteen children that he fathered; to make ends meet, Rev. Berkeley ran a boy's boarding school on the side.

Berkeley's main earthly preoccupation was Natural Science. He was attracted to natural science early, and typical of naturalists of his time, actively collected all sorts of biological specimens in Britain, developing more than passing familiarity and expertise with plants, fungi, mosses, algae, and molluscs. His first scientific publications were about British molluscs and he contributed important observations and illustrations to Lovell Reeve's (1863) book on molluscs of the British Isles. He undertook early research into control of grape vine diseases and published many horticultural and biological articles in *The Gardener's Chronical*. He published summaries of the British

biota in books such as his *Handbook of British Mosses* (Berkeley 1863), and *Introduction to Cryptogamic Botany* (Berkeley 1857). His *Outlines of British Fungology* (Berkeley 1860), based on Fries' *Systema Mycologicum*, amplified significantly that work through the addition of newly collected British species and specimens, while providing useful illustrations of the British mycota. The meticulously detailed descriptions of fungi that he prepared for the *Outlines* and for volume five of James Edward Smith's *The English Flora* (Berkeley 1836) lead the Royal Botanic Gardens at Kew to provide him with fungal material sent to the Gardens from the far-flung British Empire. He studied fungi collected by Charles Darwin during his voyage on the *Beagle* and received collections of fungi from Sri Lanka (then Ceylon), Australia, the Philippines, Cuba and both coasts of America. He published important early compilations of fungi from exotic places, including Australia, Ceylon, Cuba and the United States with his younger protégée, Christopher Edmund Broome, and his American collaborator and fellow cleric, Moses Ashley Curtis (Berkeley and Broome 1871, 1880; Berkeley and Curtis 1849–1850, 1859, 1860; see also Petersen 1980, Pfister 1978 for information about Curtis).

What with his clerical and parental requirements, Berkeley somehow managed to publish more than 400 scientific papers on fungi, alone or in collaboration with others (especially C.E. Broome). In these, he described over 5000 species of fungi and his herbarium contains some 10,000 specimens, which he ultimately gave to Kew. The Irish potato famine of 1845 caused him to shift his attention from taxonomy to plant pathology, and he identified the cause of the potato blight (the fungus now called *Phytophthora infestans*). Between 1854 and 1880, Berkeley published on pathogenic fungi in *The Gardener's Chronicle*.

Berkeley identified and described fungi in all major groups and, at least for the *Hypocreaceae*, Berkeley's specimens and publications are foundational in the sense that some of the oldest names are attributable to him.

Under the provisions of the Melbourne International Code of Nomenclature for Algae, Fungi and Plants, which requires the names of teleomorphs and anamorphs to compete on the basis of priority of their publication, many of those most prominent names are replaced by the earlier published names of their asexual forms. Most notably, the genus *Hypocrea* has been replaced by *Trichoderma* (Bissett & al. 2015).

My long-ago goal of monographing the genus *Hypocrea* was never realized. Work toward that goal required study of the type collections of species described by Berkeley. Such study was essentially destructive to the irreplaceable type

collections. Given the foundational aspect of Berkeley's species, I have felt it imperative that I make available my observations of these historically valuable specimens to all who wish to consider the names of species for which these specimens form the basis. In addition, transferring the *Hypocrea* epithets to their nomenclaturally and taxonomically appropriate genus will ensure that Berkeley's work will not be entirely lost; those names cannot now be erased by newly named species.

Berkeley and his collaborators, Cooke and Curtis, described 55 species of *Hypocrea*, including two varieties, and Berkeley recombined four species into the genus. Over time, our understanding of genera of the *Hypocreales* has advanced far beyond what was known in middle of the 19th Century. About half (28) of Berkeley's species are to be excluded from *Hypocrea* (now, *Trichoderma*); all but a few of them belong to genera of the families *Bionectriaceae*, *Clavicipitaceae*, or *Hypocreaceae* (*Hypocreales*). Despite generic reconfigurations, what is perplexing about Berkeley's taxonomy is that while he obviously had a good understanding of what we think of today as constituting the *Hypocreales* (typically species having bright- or light-colored, but always fleshy ascomata), how he could have been so wrong in including in *Hypocrea* species having carbonaceous, black ascomata (*H. ravenelii*, now a synonym of *Melogramma campylosporium*, a genus of the Diaporthales, and *H. viridirufa*, which is *Penzigia viridirufa* of the *Xylariaceae*), perplexes me.

Following are observations made during my approximately twenty-five year long study of the type collections of all the species of *Hypocrea* that Berkeley and his collaborators proposed, and those species that were combined in *Hypocrea* by him. The taxonomy of these species is updated, new taxonomy is proposed for some, and life-cycles and DNA sequences based on recent collections are provided.

Species of *Hypocrea* described by M.J. Berkeley and collaborators

Currently accepted species are indicated in boldface

Hypocrea albofulva Berk. & Broome, J. Linn. Soc. Bot. 14: 113. 9 Oct 1873. Fig. 1 A–E

≡ ***Trichoderma albofulvum* (Berk. & Broome) Jaklitsch & Voglmayr**, Mycotaxon 126: 145. 2013.

Type: [Ceylon, Nuwara Eliya], No. 5 (K, herb. Berkeley). HOLOTYPE

Epitype (Bissett & al., 2015): [specimen] THAILAND. PRACHINBURI PROVINCE: Khao Yai National Park. Princess Trail, 4 km S of park headquarters in disturbed forest, alt. 720 m. 14°28'N 101°22'E, on black fungus on decorticated wood, 6 Sep 2001, *G.J. Samuels 9224*, *M. Réblova*, *R. Nasit* (BPI 841392).

Ex-epitype culture: G.J.S. 01-265 = CBS 114787.

Representative sequences: *tefl1*: DQ 835494, *rpb2* KR094870.

Additional specimens examined: THAILAND. NAKHORN NAYOK PROVINCE: Khao Yai National Park. N of Khao Yai forest headquarters, trail from main road to Bun Phai, disturbed forest, alt. 750 m. 14°28'N 101°23'E, on Xylariaceae on decorticated wood, 6 Sep 2001, *G.J. Samuels 9253*, *M. Réblova*, *R. Nasit* (BPI 841382, BioTek; culture G.J.S. 01-262 = CBS 114786); same locality, second collection, on bark of rotting log, *G.J. Samuels 9247*, *M. Réblova*, *R. Nasit* (BPI 863804; culture GJS 01-249).

Observations: The holotype specimen consists of several fragments of wood with bark glued to a piece of paper. Stromata effused, the largest 10 mm long × 5 mm wide, to 1 mm thick, more or less white but ostiolar openings appearing as orange areolae and confluent such that the stroma appears orange with a sterile white margin; the coalesced ostiolar regions often giving the appearance of tracks on the stroma surface; surface plane, perithecial elevations not evident, velvety or woolly; stroma and perithecia KOH–. The stroma surface hyphal; hyphae 5–6 µm wide, smooth, wall at most slightly thickened, many free ends protruding a short distance as warted hairs. In section stroma surface region ca. 25 µm thick, composed of compact, intertwined hyphae, walls gold-colored, cells ca. 5 µm wide, walls, 0.5 µm thick. Cells of the perithecial interior with hyphal characters, tending to be at most slightly swollen, 5–7 perithecia ± scattered, globose to ovoidal, ca. 250 µm diam. Asci cylindrical to narrowly clavate, 70–80 × 5 µm, apex with a conspicuous ring, part-ascospores becoming disorganized. Part-ascospores hyaline, finely warted, dimorphic; distal part subconical to subglobose, 3.5–3.7(–4.2) × 3.0–3.2(–3.5) µm; proximal part tending to be oblong, 3.7–4.5 × 2.7–3.2 µm (N = 11).

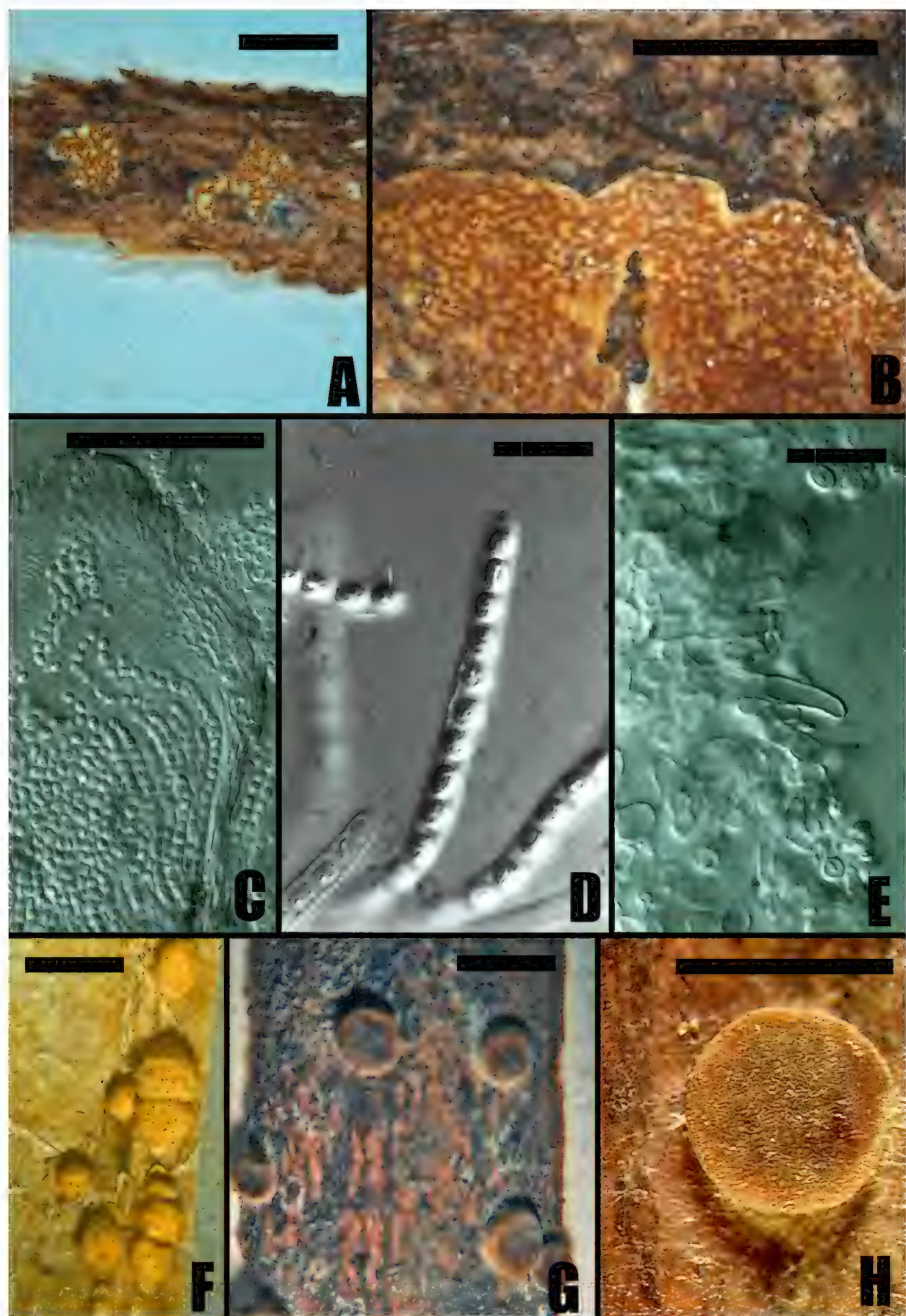


FIG 1. A–E. *Hypocrea albofulva*. A, B. Stroma. C. Cross section of a perithecium showing the lateral wall and the papilla. D. Ascus. E. A single hair protruding from the stroma surface. A – E. Type. F. *H. armeniaca*, stroma. Type, FH–Gray. G. *H. artocreas*, stromata. Type. Scale bars: A, B, F, G = 5 mm; C = 100 10 μ m; D, E = 10 10 μ m; H = 2 mm.

A recent collection from Thailand agrees well with the type collection from Sri Lanka in its morphology and geography. The asci in the recent Thai collection are the same size as in the type collection but the apical ring is often obscure and ascospores remain uniseriate. Ascospores ($n = 30$) are dimorphic; distal part subglobose, $(3.0-3.2-3.7(-4.2) \times (3.0-3.2-4.0(-4.2) \mu\text{m}$; proximal part oblong to wedge-shaped, $(3.5-4.0-5.0(-5.5) \times (2.5-2.7-3.2(-3.7) \mu\text{m}$.

Commentary: *Trichoderma albofulvum* is most readily recognized by its thin, effused stromata and orange, areolate ostiolar areas separated by conspicuous white tissue, giving the surface of the stroma the appearance of animal tracks through white snow. There was no obvious fungus host for the type specimen, from Sri Lanka, but the stroma of the Thai collection grows over black stromata of xylariaceous fungi.

Trichoderma albofulvum is a member of the Viride Clade of *Trichoderma* (Jaklitsch & al. 2006). It is very similar to *H. ochroleuca* Berk. & Ravenel, a species described from the U.S.A. (South Carolina) (see below and Jaklitsch 2011). The main difference between the two, apart from their geographic distributions, is that ascospores of the latter species are somewhat larger than those of *T. albofulvum*. Doi (1972) reported *H. albofulva* from Japan and he illustrated a verticillium-like anamorph with green conidia. He regarded *H. ochroleuca* as a later synonym of *H. albofulva* and reported the species from Peru. That *T. ochroleucum* or *T. albofulvum* occur over such wide ranges (North America, Europe, Peru, Japan, Sri Lanka, Thailand) is dubious. The stromal morphology seen in *T. albofulvum* and *T. ochroleucum* is generalized, shared by other probably undescribed species, similar to what is seen in the Viride Clade (Jaklitsch & al., 2006). We have seen additional specimens that have stroma morphology consistent with that of *H. albofulva* and *H. ochroleuca*. A specimen from Cameroon (BPI 863849) has monomorphic, subglobose part ascospores; ascospores in a Puerto Rican collection (BPI 748374) are considerably smaller than in *H. albofulva* or *H. ochroleuca*.

Hypocrea armeniaca Berk. & M.A. Curtis., Proc. Am. Acad. Arts Sci. 4: 128. 1860. Fig. 1 F

= **Hypocrella** sp.

Type: Herbarium of the U.S. North Pacific Exploring Expedition under Commanders Ringgold and Rodgers, 1853–56. No. 390 [155]. *Hypocrea armeniaca*. Bonin Islands, ‘shady hillside,’ on leaves of *Apocynaceae*, C. Wright

(FH–Gray, LECTOTYPE hic designatus IF901687; BPI 631322).

Observations: There are two portions of this specimen in FH; they are identical. No stromata could be found in the BPI part. The FH specimen consists of a cut piece of leaf. Several tuberculate to pulvinate stromata are seated on scale insects along the midrib of the leaf. The stromata are 2–3 mm diam, 1.5 mm high, yellow. Ostiolar openings appear as small, orange dots. There is no reaction to KOH. I here designate the FH portion as lectotype.

Commentary: This is a species of *Hypocrella*, as was noted by Lloyd (1923: 1217), and certainly distinct from the illegitimate *H. armeniaca* Berk. & M.A. Curtis, in Berkeley (1875).

Hypocrea armeniaca Berk. & M.A. Curtis, in Berkeley, Grevillea 4: 15. Sep 1875. nom. illeg. non *H. armeniaca* Berk. & M.A. Curtis 1860.

Type: “*Hypocrea lata*, B. & C. 6269,” Sprague 791 *bis* (FH!). HOLOTYPE

Observations: The holotype specimen consists of a fragment of bark with a thin, separable apricot-colored or buff, tomentose subiculum. There are neither obvious perithecia nor is an anamorph visible.

Commentary: *Hypocrea armeniaca* Berk. & M.A. Curtis (1875) is a later homonym of *H. armeniaca* Berk. & M.A. Curtis (1860), which is a species of *Hypocrella*. According to Berkeley (1875) *H. armeniaca* 1875 forms a thin, apricot-colored subiculum that “looks like *Corticium ochroleucum*, at length fertile perithecia scattered, of a deeper tint.” Berkeley did not describe ascospores for *H. armeniaca* 1875. The specimen and description do not suggest that this is a species of *Hypocrea*. Possibly *H. armeniaca* 1875 is *Hypomyces armeniacus* Tul. & C. Tul./*Cladobotryum verticillatum* (Link) S. Hughes, a species that completely destroys its agaricaceous hosts, and the subiculum and perithecia appearing to have formed on litter, decorticated wood or soil (Rogerson & Samuels 1994).

Hypocrea artocreas Berk. & Broome, J. Linn. Soc. Bot. 14: 111. 9 Oct. 1873. Fig. 1G, H

Type: “110 *Hypocrea artocreas*, B. & Br.” Ceylon, GHKT, Nov. 1868 (K, Hb. Berkeley 1879!). HOLOTYPE

Observations: The type specimen consists of a few pieces of palm petiole glued to a piece of stiff paper. Stromata are scattered, discrete, discoidal, 2–3 mm diam. Stromal surface yellow–brown, velvety; sides perpendicular to the substratum, tan; a narrow fringe of tan hyphae anchors the stroma to the substratum. Perithecia were not seen.

Commentary: The type specimen is an immature species of *Hypocrea*. The protologue notes ‘sporidia not mature.’ The color and pruinose stroma surface suggest that this species is a species of *Trichoderma*.

Hypocrea atramentosa Berk. & M.A. Curtis in Berkeley, J. Linn. Soc. Bot. 10: 377. 1868.

≡ *Myriogenospora atramentosa* (Berk. & M.A. Curt.) Diehl, Agr. Monogr. 4: 59. 1950.

≡ *Hypocrella atramentosa* (Berk. & M.A. Curt.) Sacc., Michelia 1: 323. 1879.

≡ *Epichloë atramentosa* (Berk. & M.A. Curt.) Cooke, Grevillea 12: 103. 1884.

≡ *Ophiodothis atramentosa* (Berk. & M.A. Curtis) Earle, Bull. Torrey Bot. Club 27: 121. 1900.

≡ *Dothichloë atramentosa* (Berk. & M.A. Curtis) G.F. Atk., J. Mycol. 11: 260. 1905.

= *Myriogenospora paspali* G.F. Atk., Bull. Torrey Bot. Club 21: 225. 1894. Type material of this species was not examined for this study.

Type: “No. 4018 *Hypocrea atramentosa* B. & C.,” in *Andropogon*, Alabama, Beaumont (K, Hb. Berkeley 1879!). LECTOTYPE, *hic designatus* IF901688

Commentary: The nomenclature and taxonomy of this species have been discussed by Diehl (1950). The protologue of *H. atramentosa* referred to two specimens, viz. no. 419 from Cuba and no. 4018 from Alabama, both of which were studied by Diehl (1950). According to Diehl, these specimens represent two species, respectively *Myriogenospora atramentosa* and *Balansia henningsiana* (Möller) Diehl. Specimen 419 must be taken as the lectotype; specimen 4018 was cited in the protologue as an additional collection. The nomenclator given above is taken from Diehl (1950).

Hypocrea bambusae Berk. & Broome, J. Linn. Soc. Bot. 14: 113. 1873 non Höhnelt 1920. Fig. 2 A, B

≡ *Hypocrella bambusae* (Berk. & Broome) Sacc., Michelia 1: 323. 1878.

≡ *Balansia bambusae* (Berk. & Broome) Petch, Ann. Roy. Bot. Gard. Peradeniya 7: 97. 24 May 1920

Type: Ceylon, Jan 1855, G.H.K.T. (K(m) 62649, Hb. Berk.). LECTOTYPE, *hic designatus* IF901689

Observations: The type specimen consists of the terminal branchlet of a bamboo. Dark red (dry) or brown (3% KOH) stromata, 1–2 mm diam, emerge

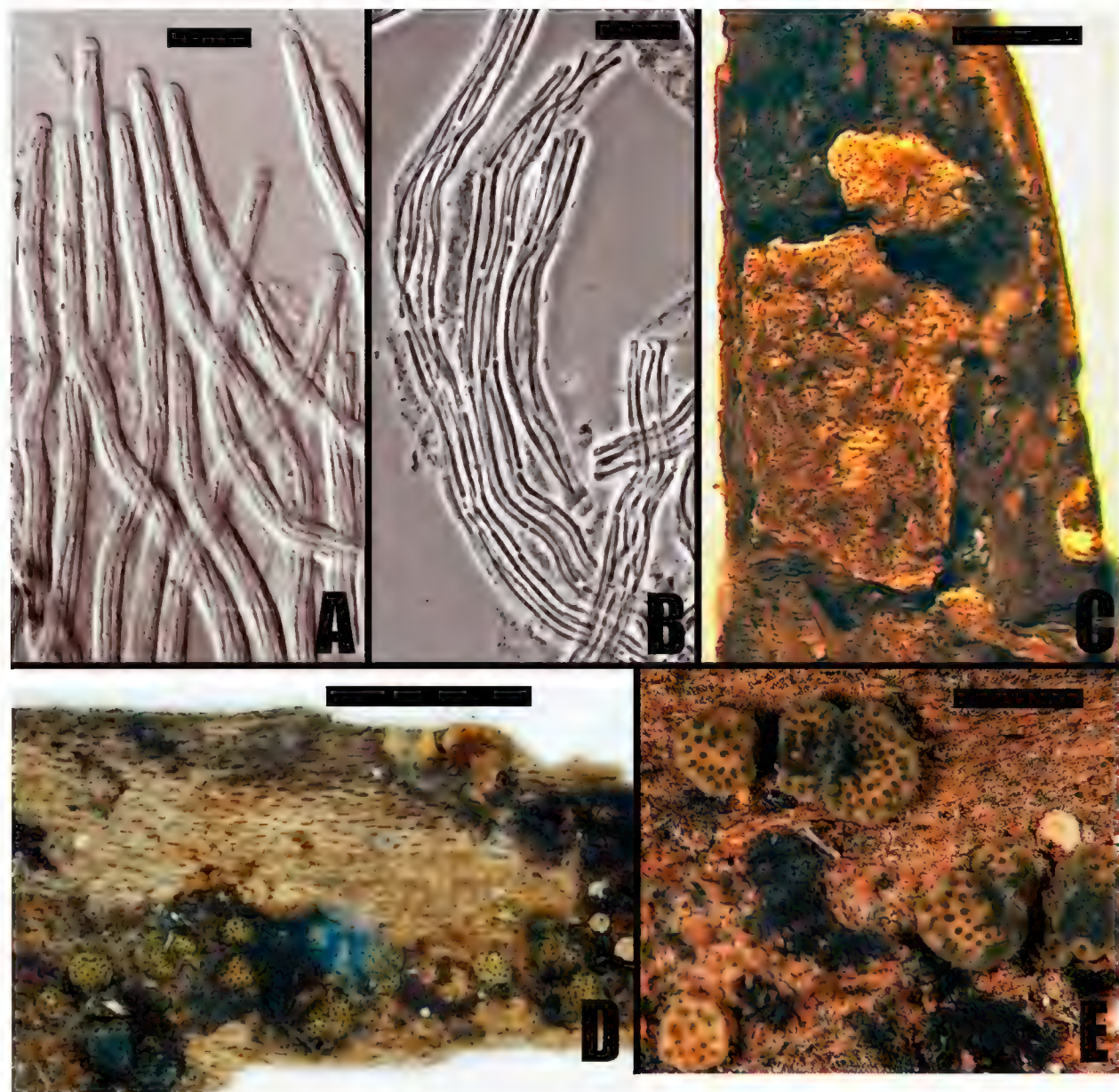


FIG 2. A, B. *Hypocrea bambusae*. Asci, stained in 1 (aq.) phloxine. Type. C. *H. carteri*, stroma. Type. D, E. *H. catoptron*. Stromata. Lectotype. Scale bars: A, B = 10 µm; C, E = 2 mm; D = 5 mm.

from the terminal ends of what appear to be flower heads. The stromata are subglobose to slightly turbinate and with a slightly papillate tip. Asci are typical of the *Clavicipitaceae*, having a thickened apical cap. Ascospores appear to be 3-septate.

Commentary: As I have not examined the co-type specimen of *H. bambusae*, reportedly deposited in Peradeniya, I designate the portion in K as lectotype.

Petch (1916) gave a full description of this species based on his study of a ‘co type’ at Herb. Peradeniya. That description follows: “The fungus is parasitic on some species of bamboo. Its stromata are situated at the apex of short lateral branches, and it appears probable that these owe their suppressed condition to the action of the fungus. Part of the fungus consists of a mass

of hyphae, which encloses the inner leaves of the terminal bud and forms a pseudostroma, hidden by the outer leaves. At the apex of this the external stroma is produced. The external stroma is black, hemispherical, plain beneath and somewhat flattened above, about 1.5 mm. Diameter, rough with close-set conical ostiola, which project up to 0.1 mm. The perithecia are flask-shaped, usually close-set and sometimes wedge-shaped owing to the lateral compression, regularly arranged round the periphery of the upper surface; they are up to 0.6 mm deep (including the neck) and 0.2 mm diameter. The asci are about 400 μ long and 4–6 μ diameter; the spores are about as long as the ascus, and 1–1.5 μ diameter, apparently continuous.” Petch (1916) tentatively placed the species in *Balansia*, but repeated the combination in 1920 Diehl (1950) did not include the species in his floristic monograph of *Balansia* of the Americas.

According to Petch (1925), *Hypocrea bambusae* Höhn. 1920 is a good species of *Hypocrea* and thus should be considered for transfer into *Trichoderma*.

“*Hypocrea carnea* Berk. & M.A.Curtis” Ined.

Commentary: Dingley (1956) commented that this name was reported from New Zealand by Colenso (1893) and is probably an error for *H. carnea* Kalchbr. & Cooke.

Hypocrea carteri Berk. & Cooke in Cooke, Grevillea 12: 79. 1884. Fig. 2 C

≡ *Hypocreopsis carteri* (Berk. & Cooke) Sacc., Syll. Fung. 9: 981. 1891.

= *Stilbocrea macrostoma* (Berk. & Cooke) Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Wien, Math-Naturwiss. Cl., Abt. 1, 118: 1185. 1909.

Type: ‘Bombay, H.B. Carter 1862’ (K, Hb. Berkeley 1879!). HOLOTYPE

Observations: The holotype specimen consists of a piece of bark with a stroma and a packet that contains another piece of bark with a stroma. Stromata are indefinitely effused, off-white, perithecia densely disposed, immersed with only the papilla emerging, orange. A few synnemata arise from the stroma; synnemata scattered, light orange; remains of a few black synnemata are present. Asci narrowly clavate; ascospores 1-seriate with overlapping ends. Ascospores ellipsoidal to fusiform, hyaline, spinulose, equally 2-celled, (11.5–)12.0–13.7(–14.0) $\times$ (4.7–)5.0–5.7(–6.0) μ m (N=20).

Commentary: The type specimen of *H. carteri* is typical of *S. macrostoma*. *Stilbocrea macrostoma* is a common, pantropical species. It has been redescribed and illustrated by Rossman & al. (1999).

Hypocrea catoptron Berk. & Broome, J. Linn. Soc. Bot. 14: 112. 1873. Fig. 2 D, E

= *Hypocrea sulphurella* Kalchbr. & Cooke, Grevillea 9: 26. 1880.

= *Hypocrea flavovirens* Berk., in Cooke, Grevillea 12: 100. 1884.

= ***Trichoderma catoptron*** P. Chaverri & Samuels, Stud. Mycol. 48: 43. 2003, nom. cons. prop. (Samuels 2014).

Lectotype: [Sri Lanka], Central Province, on decorticated wood, Feb. 1868, Dolosbagey (K, No. 557; Chaverri & Samuels 2003).

Epitype: BPI 843645 (Chaverri & Samuels, Stud Mycol. 48: 45. 2003).

Ex-epitype culture: G.J.S. 02-76 = CBS 114232 = DAOM 232830.

Representative sequences: *tefl*: AY 737726, *rpb2*: AY391900.

Commentary: The protologue cites three specimens, viz. no. 5 in part, no. 557, both from [Sri Lanka] Central Province, Feb 1865, and Dolosbagey. Four specimens in K are noted as being ‘type,’ including these three collections and no. 557 *bis*. The Dolosbagey specimen was described later as *H. subrufa* Berk. & Cooke (Cooke, 1884). The other three specimens are apparently the same species. Chaverri & Samuels (2003) designated the specimen ‘557’ as lectotype and redescribed and illustrated the species. They also described its anamorph as *Trichoderma catoptron* and epitypified the species with the recent Sri Lankan specimen from which the type of *T. catoptron* was derived. Samuels (2014) proposed conservation of *T. catropton* over the older epithets *H. sulfurella* and *H. flavovirens*.

Trichoderma catoptron is known only from South Africa, India and Sri Lanka. It occurs on bark of decaying trees, less frequently on decorticated wood and resupinate basidiomycetes. Chaverri & Samuels (2003) redescribed the species. It is most closely related to *T. ceraceum* P. Chaverri & Samuels, *T. cinnamomeum* P. Chaverri & Samuels and *T. stramineum* P. Chaverri & Samuels (Chaverri & Samuels, 2003).

Hypocrea cerebriformis Berk., J. Linn. Soc. Bot. 13: 177. 1872, non Beeli 1926. Fig. 3 A–E

= ***Trichoderma cerebriforme*** (Berk.) Samuels in Bissett & al., IMA Fungus 6: 269. 2015.

Type: “*Hypocrea cerebriformis* B., Australia, M & B” (K, Hb. M.C. Cooke 1885!). HOLOTYPE.

Representative specimen: Indonesia. North Sulawesi: Eastern Dumoga-Bone National Park, at confluence of Toraut & Tumpah Rivers, Project Wallace

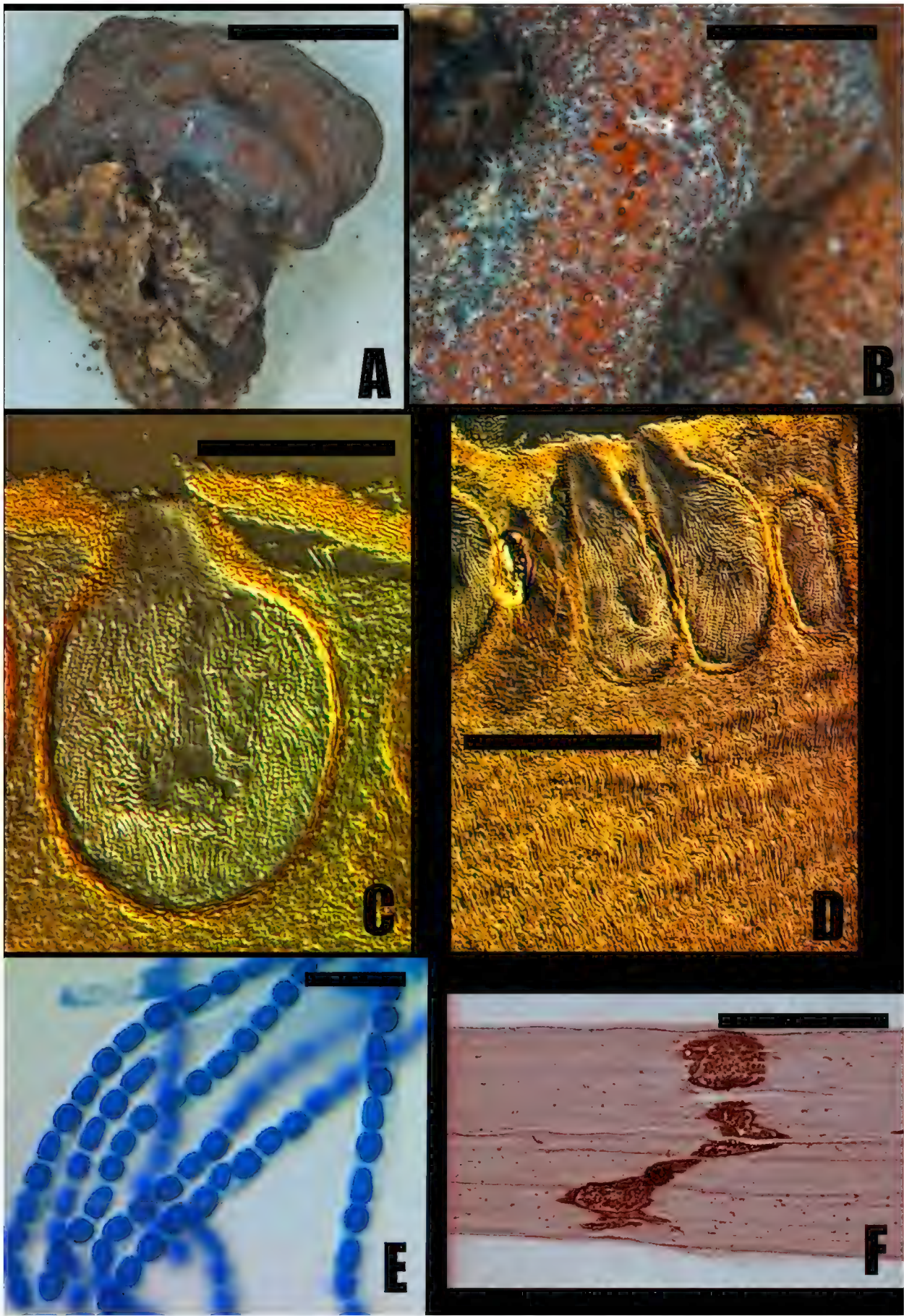


FIG 3. A–E. *Hypocrea cerebriiformis*. A, B. Stromata. C, D. Sections through the stroma and mature perithecia. E. Asci and ascospores. All from the type. F. *H. cyperacearum*, stroma. Type. Scale bars: A, F = 10 mm; B = 5 mm, C = 100 μ m, D = 200 μ m, E = 10 μ m.

Base Camp; N 0° 34' E 123° 57', alt. 211 m, on wood, Sep 1985, G.J. Samuels (2359) (BPI 881335 ex NY).

Representative culture: G.J.S. 85-845 (CBS 139045)

Representative sequence: *tef1* KP109824

Observations: The type specimen consists of a single stroma glued to a piece of stiff paper. The substratum is decorticated wood. Stroma stipitate/capitate. Stipe stout, ca. 7 mm diam × 10 mm long, highly convoluted and pitted. The cap ca. 20 mm diam, deeply convoluted, cerebriform, ± rufous; red-brown in 3% KOH, internal tissue orange in 3% KOH; stroma surface scaly. Perithecial elevations minute; perithecial openings appearing as darker brown dots against the surrounding tissue. Stroma comprising three regions. Surface region ca. 45 µm thick, cells ± angular, walls 1.5–2 µm thick, pigmented. Tissue immediately below the surface and below perithecia densely intertwined hyphae. Cells of the stipe brick-like with long axis parallel to long axis of stipe. Perithecia crowded, elliptic in section, (350–)370–40(–480) µm high, (150–)180–280(–300) µm wide; ostiolar canal (65–)75–115(–125) µm long; perithecial papilla formed of small cells, not anatomically distinct from the cells of the surrounding stroma surface. Asci cylindrical, 65–8(–95) × (3.5–)4.2–6.0(–6.7) µm, apex thickened, with a pore, ascospores uniseriate. Part-ascospores hyaline, at most finely spinulose, dimorphic; distal part subglobose, (3.5–)4.0–4.5(–4.7) × (3.2–)3.5–4.0 µm; proximal part wedge-shaped, (3.5–)4.0–4.5(–5.5) × (2.7–)3.0–3.5(–3.7) µm.

Commentary: *Trichoderma cerebriformis* is distinctive for its stout stipe and convoluted cap. Similar species having stipitate/capitate stromata include *T. brevipes* (Mont.) Samuels, *H. poronioideum* (Möller) Samuels, *H. capitata* Samuels & Lodge (Samuels & Lodge (1996), *H. petersii* Berk. & M.A. Curtis and *T. peltatum* (Berk.) Samuels, Jaklitsch & Voglmayr. Doi (1975a) compared *H. cerebriformis* with several other species and described a *T. cf. longibrachiatum*-like anamorph for it based on collections made in Japan. Doi (1976) reported *H. cerebriformis* from Peru and Rogerson & al (1990) reported the species from central Brazil (Roraima). Whether any of these collections made outside of Australia are actually *T. cerebriformis* remains to be proven by additional collections, but the name is being used for collections that are at least superficially alike. For this reason I am confident that *H. cerebriformis* is a species of *Trichoderma*, but have not epitypified it.

Hypocrea cervina Berk. & M.A. Curtis, in Berkeley, J. Linn. Soc. Bot. 10: 376. 1869 (basonym).

≡ *Amplistroma cervinum* (Berk. & M.A. Curtis) Samuels, **comb. nov.**
IF901686

Type: Cuba, Wright 773, Fungi Cubensis 773 (K! HOLOTYPE. FH, Curtis! ISOTYPE).

Observations: The holotype specimen of *H. cervina* consists of several pieces of decorticated wood glued to a piece of stiff paper. Stromata are superficial, pulvinate, to $3 \times 2 \text{ mm} \times 0.5 \text{ mm}$ thick, brown, formed of smooth, compact, curved and sinuous, short-celled, $2.5\text{--}3 \mu\text{m}$ wide hyphae. Hyphae at stroma surface more densely interwoven than hyphae within, brown–golden in lactic acid. Perithecia immersed to different levels, each comprising a globose venter and a periphysate neck of variable length. Venter ca. $400 \mu\text{m}$ diam, the interior completely lined with asci; perithecial wall ca. $15 \mu\text{m}$ wide, formed of a single region of densely interwoven, hyphal tissue, golden in lactic acid. Asci narrowly clavate, $20\text{--}30 \times \text{ca. } 3 \mu\text{m}$, stalked, 8-spored, apex simple. Ascospores globose, $2.5\text{--}3 \mu\text{m}$ diam, hyaline, smooth. Paraphyses not seen.

Commentary: *Hypocrea cervina* is not a member of the *Hypocreales*, the fleshy stroma notwithstanding, but it fits well with the concept of *Amplistroma* Huhndorf & al. (*Amplistromataceae*, *Sordariomycetes Incertae sedis*, Huhndorf & al. 2009). In the formation of an extensive stroma and in the minute, globose ascospores *A. cervina* resembles *A. xylarioides* (Pat.) Huhndorf & Samuels (Huhndorf & al. 2009), which was collected on a log in Ecuador. The stroma in the type specimen of *A. xylarioides* (FH! NY!) is club-shaped, ca. 2 cm tall and has hemispherical or cerebriform head in which perithecia are immersed. The asci have an apical ring, and although discrete paraphyses were not seen among asci, linear, saccate tissue among asci may be the disintegrating remains of paraphyses. Asci contain 8, globose, hyaline ascospores, $2.5\text{--}3.0 \mu\text{m}$ diam.

Hypocrea chlorospora Berk. & M.A. Curtis, in Berkeley, Grevillea 4: 14. 1875.

= *Trichoderma chlorosporum* P. Chaverri & Samuels, Stud. Mycol. 48: 49. 2003.

Type: “Mountains of New York, USA, on decorticated wood, Coll. Curtis #4466 (K(m) 114744!). HOLOTYPE. UNITED STATES. Connecticut: Tolland County, Salmon River State Park, on wood, 17 Sep 1988, *R. Lowen* 616 (NY 01197411!). EPITYPE (Chaverri & Samuels 2003).

Additional specimens examined: Black Mt., N.C., USA, Sept 1854, #4466 (FH!). ‘Montenegro Car sept, ad lignum carinosum ex M.A. Curtis (NYS!). Mts. N. Carolina, lign. carinosum, dedit. Curtis BPI–Michener!).

Representative culture: G.J.S. 88-33 = CBS 114231 = DAOM 232832 (ex-epitype culture of *T. chlorosporum*).

Representative sequences: *tefl*: AY737737, AY391966, AY391968. *rpb2*: AY391903, AY391906.

Commentary: The four specimens cited above are likely to have been part of a single gathering. Chaverri & Samuels (2003) took Berkeley's part (K) to be the holotype and the others to be isotypes. Although the collecting locality was given in the protologue as 'Mountains of New York No. 4466,' the material in Curtis' own collection (FH, BPI–Michener) gives North Carolina as the collecting locality. Curtis was an Episcopalian priest and teacher who lived in the Carolinas in the mid to late 19th century. He provided specimens of fungi to Berkeley, who described them. As Berkeley's part of the collection bears the collecting number 4466, it is likely that the locality data were confused and that the true locality of the type is North Carolina and not New York.

Chaverri & Samuels (2003) epitypified *H. chlorospora* and redescribed the species *T. chlorosporum*.

Hypocrea corticioides Berk. & Broome, J. Linn. Soc. Bot. 14: 111. 9 Oct 1873 non Speg. 1912.

≡ *Clintoniella corticioides* (Berk. & Broome) Petch, Ann. Roy. Bot. Gard., Peradeniya 7: 134. 1920.

= *Stilbocrea macrostoma* (Berk. & M.A. Curtis) Höhn., Sitzungsber. Kaiserl. Akad. Wiss. Wien., Math.–Naturwiss. Cl., Abt. 1, 118. 1185. 1909.

Type: "No. 645, S. of the Island, July 1868" (K, Hb. Berkeley!). HOLOTYPE

Observations: The type specimen consists of five pieces of bark glued to stiff paper. Perithecia are superficial, densely cespitose and united in great numbers in a common, cottony stroma; covering extensive areas, only perithecial openings visible. Perithecia dull orange-amber. Stroma formed of thick-walled hyphae. Asci narrowly clavate, 8-spored, apical discharge mechanism not visible. Ascospores ellipsoidal to fusiform, 12–14 × 5–6 µm, constricted in the middle, equally 2-celled, coarsely spinulose. Synnemata arising from many perithecial aggregates, colorless to white, terminating in a dull orange ball of conidia. Black synnemata not seen.

Commentary: The type specimen of *H. corticioides* is entirely typical of *S. macrostoma*.

The type specimen of *H. corticioides* Speg. (LPS 1719!) is overmature and in poor condition but could be a *hypocrea*. *Hypocrea corticioides* Speg. was

described from Argentina on bark of *Erythrina cristii-gallii*. Stroma in the type is indefinitely effused and broadly attached to the substratum, crustose, 0.7–1.0 mm thick light brown to brown; the surface is plane, perithecial elevations are not evident, ostilar openings appear as dark dots against the lighter surface. There is no reaction of stroma tissue to 3% KOH. Cells of the stroma surface, in face view, are angular to elliptic, to 15 µm diam, walls < 1 µm thick. Perithecia are ca. 225 µm tall, 125 µm wide. The perithecial papilla is formed of large clavate cells with thickened walls. The stroma surface is ca. 75 µm wide, formed of intertwined, short-celled hyphae; no free ends at the stroma surface. Stroma tissue below the perithecia mostly disorganized intertwined hyphae of uniform width, 4.5–7 µm wide, walls < 1 µm wide. Asci are few and adherent in groups. Discharged part-ascospores are hyaline, smooth or sparsely warted, subglobose to globose, (2.0–)2.2–3.0(–4.0) × (2.0–)2.2–2.5(–3.0) µm. The species was redescribed by Doi (1975a), who cited a recent collection from Colombia and a Rick collection, probably from Brazil, that was deposited in NY as *H. flava* P. Henn.

Hypocrea cyperacearum Berk. & M.A Curtis, J. Acad. Nat. Sci. Philadelphia ii, 2: 285. 1854 Fig. 3 F

≡ *Balansia cyperacearum* (Berk. & M.A. Curtis) Diehl, Agriculture Monogr. 4: 439. 1950.

Type: ‘Sph. Cyperacearum Schwein. Surinam. Herb. Schwein.’ (K(m) 52652, herb Berkeley 1879!). HOLOTYPE

Commentary: Diehl (1950) redescribed the species and provided additional synonyms.

Hypocrea deplanata Berk. & Broome, J. Linn. Soc. Bot. 14: 111. 3 Dec 1873 (basionym). Fig. 4 A–D

≡ *Trichoderma deplanatum* (Berk. & Broome) Samuels, **comb. nov.** IF 901684

Type: Sri Lanka “Cent. Province, Dec 1868, No. 1100” (K, Herb. Berkeley 1879!). HOLOTYPE

Observations: The type specimen consists of two pieces of decorticated wood glued to a piece of stiff paper. Stromata are found on only one of these pieces. Stromata effused, reaching 7 mm in extent, thin, little more than the height of a perithecium, margins firmly attached, buff to peach with a narrow fringe of white hyphae around the margin; surface plane, perithecial elevations not evident, perithecial openings appearing as orange dots against the lighter stroma tissue; not reacting to 3% KOH. Perithecia lenticular in section,

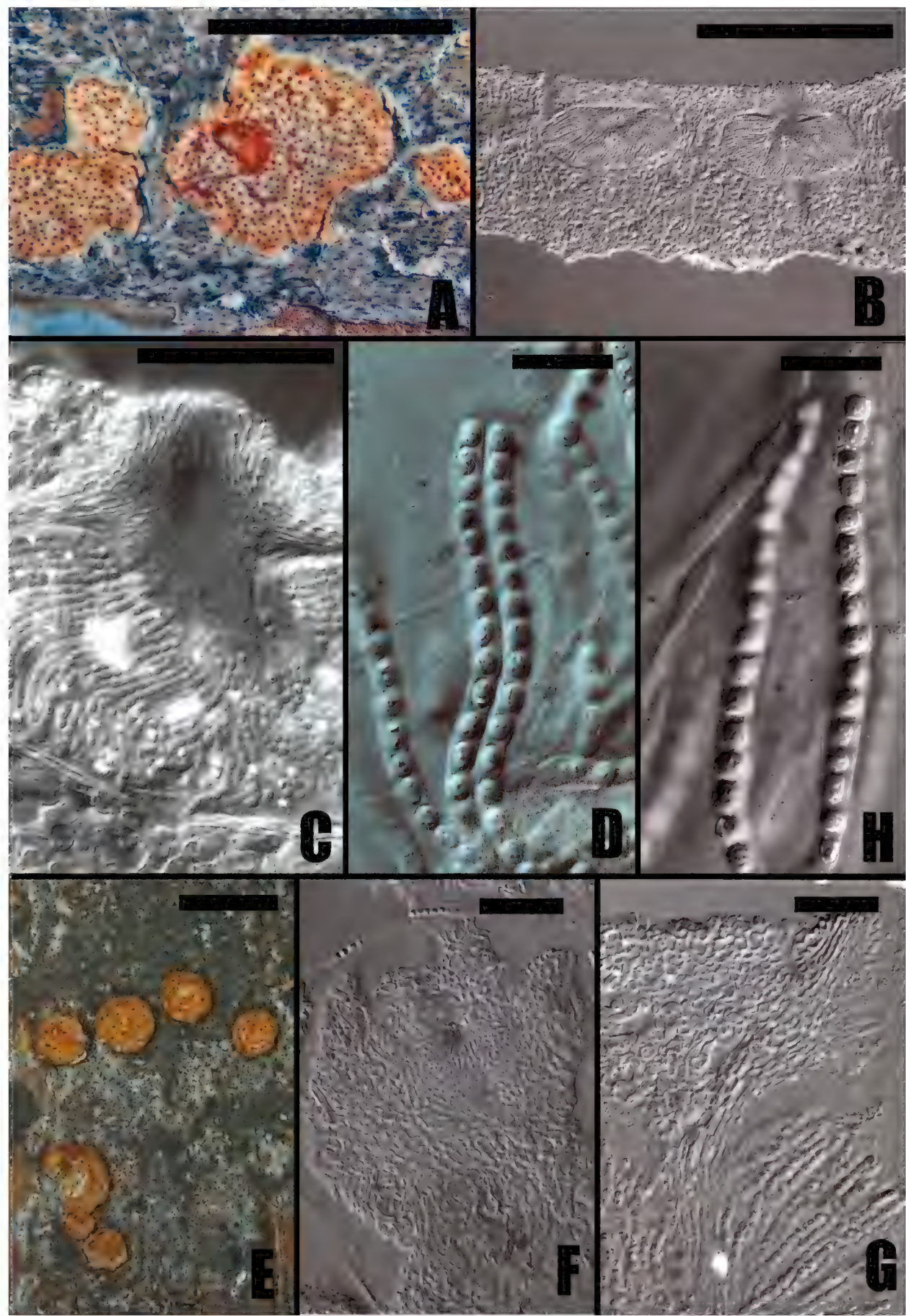


FIG 4. A–D. *Hypocrea deplanata*. A. Stromata. B. Section through a mature stroma. C. Section through the perithecial apex. D. Asci and ascospores. Type. E–H. *H. discella*. Type. E. Stromata. F. Stroma surface in face view. G, H. Asci and ascospores. Section through a mature stroma showing the surface region and the perithecial papilla. Scale bars: A = 10 mm, B = 500 μ m, C = 200 μ m, D, E = 10 μ m, F = 2 mm, G, H = 20 μ m.

wider than tall, 240–275 μm tall, 285–390 μm wide; ostiolar canal 60–90 μm long. Stromal surface region ca. 25 μm thick, composed of smooth, compact, intertwined, 4–5 μm wide hyphae; no free ends of hyphae seen at stroma surface. Tissue below the stroma surface is of loosely intertwined hyphae. Tissue below the perithecia comprising highly compact hyphal elements. The perithecial papilla formed of a palisade of $\pm$ hyphal elements with slightly enlarged, ca. 3 μm wide tips. Asci 55–70 $\times$ (2.5–)3.0–4 μm , apex inconspicuously thickened possibly with a pore, 8-spored. Ascospores hyaline, smooth, dimorphic; distal part subglobose to ellipsoidal, 2.7–3.2 $\times$ 2.5–2.7 μm ; proximal part oblong to wedge-shaped, 3.0–3.7 $\times$ 2.2–2.5 μm .

Commentary: Morphologically similar species were discussed in papers by Overton & al. (2006 a,b) and Jaklitsch (2011), but *T. deplanatum* seems to be distinct among the *Trichoderma* species that have effused stromata.

Hypocrea discella Berk. & Broome, J. Linn. Soc. Bot. 14: 111. 1873 [1875] (basionym). Fig. 4 E–H

$\equiv$ *Trichoderma discellum* (Berk. & Broome) Samuels, **comb. nov.** IF 901683

Type: Ceylon, “5. *Hypocrea discella*, B. & Br. Peradeniya, Nov 1867, G.H.K.T.” (K, Herb. Berkeley 1879!).

Observations: The type specimen consists of fragments of decorticated wood, each with stromata. Stromata scattered, discrete, pulvinate, nearly circular in outline, margins slightly free, (1–)2 mm diam, 0.5 mm tall, brownish orange (K&W 6C8), perithecial openings darker; stroma surface slightly wrinkled, perithecial elevations not evident, not reacting to 3% KOH. Stroma surface region 15–20 μm thick, forming a continuous crust over the entire stroma, cells angular, 3–4 μm diam, walls ca. 0.5 μm thick. Tissue immediately below stroma surface of loosely intertwined, 3–4 μm wide hyphae. Tissue below perithecia *texture epidermoidea* to *t. globosa*, cells 7–10 μm diam, walls 1.5–2.0 μm thick. Perithecia nearly globose in section, 195–225 μm tall, 100–165 μm wide, ostiolar canal ca. 30 μm long. Ostiolar opening formed by a narrow zone of hyphal elements, hardly distinct from the surrounding stroma surface, not protruding through the surface region. Asci cylindrical, 60–80 $\times$ 4.0–4.5 μm , apex thickened and with a pore, 8-spored, ascospores 1-seriate. Ascospores hyaline, spinulose, dimorphic. Distal part-ascospores globose to subglobose, 3.0–3.2 $\times$ 2.5–3.0 μm . Proximal part-ascospores oblong, 3.0–4.2 $\times$ 2.2–2.7 μm .

Commentary: *Hypocrea discella* is a species of *Trichoderma*. Stromata in the holotype appear to be seated on a black, possibly xylariaceous ascomycete.

Hypocrea discoidea Berk. & Broome, J. Linn. Soc. Bot. 14: 113. 1873. Fig. 5 A, B

≡ *Hypocrella discoidea* (Berk. & Broome) Sacc., Michelia 1: 322. 1878.

Type: Ceylon, on dead leaves of *Zingiber* (K, Herb. Berk.!). HOLOTYPE.

Observations: The holotype specimen consists of a piece of stiff paper with two pieces of leaf glued to it. There are scale insects on the leaf pieces. Five 3 mm–diam, orange stromata are glued separately to the paper. Each stroma is a hemispherical aggregate comprising 100 or more cespitose, orange perithecia. Ascospores are filiform and remain entire in the ascus. The ascal apex is typical of the *Clavicipitaceae*. Hywel-Jones & Evans (1993) discussed the taxonomy and ecology of *Hypocrella discoidea* and its anamorph, *Aschersonia samoensis* Henn.

Hypocrea farinosa Berk. & Broome, Ann. Mag. Nat. Hist. Ser. 2, 7: 186. 1851. Fig. 5 C–G

≡ *Protocrea farinosa* (Berk. & Broome) Petch, J. Bot. 75: 219. 1937.

Type: King's Cliff, Milton, on fallen branches, coll. Mr. Henderson (K(m) 48950, herb Berk.!). LECTOTYPE, *hic designatus*. IF 901685

Observations: The type specimen consists of seven pieces of bark glued to a piece of stiff paper on which collecting details are written. One piece is devoid of perithecia. A thin, arachnoid, white to cinereous mycelium spreads over the host. Numerous perithecia are seated on and partially immersed in the mycelium. Perithecia discrete, pale yellow, not changing color in 3% KOH, collapsing to leave a short papilla seated in the middle of the cup formed by the collapse. Perithecia completely covered by densely compacted hyphae; hyphae of the subiculum loosely cottony, smooth, ca. 4 µm wide. Perithecia globose, 60–100 µm diam with a minute papilla. Perithecial wall laterally 18–20 µm wide, formed of several layers of small, slightly thick-walled cells. Perithecial papilla undifferentiated, clavate elements not observed, only periphyses protrude through the apex. Asci (n = 31) cylindrical, (47–)52–60(–67) × (3.5–)4.2–5.7(–6.2) µm, apex thickened, with a pore; ascospores uniseriate. Part ascospores (n = 40) hyaline, dimorphic, finely spinulose (when stained in cotton blue, otherwise appearing smooth); distal part-ascospores are subglobose, (3.0–)3.5–4.0(–4.5) × (2.0–)2.5–3.0(–3.2) µm; proximal part-ascospores wedge-shaped to oblong, (3.2–)3.5–4.5 × (2.0–)2.2–2.7(–3.0) µm.

Commentary: Berkeley (1851) cited two specimens in the protologue to this species, viz. King's Cliff and a more downy form from Bach Hall. We have seen only the King's Cliff specimen, which I designate here as lectotype. Perithecia in this collection are forming on a thin, effused polypore.

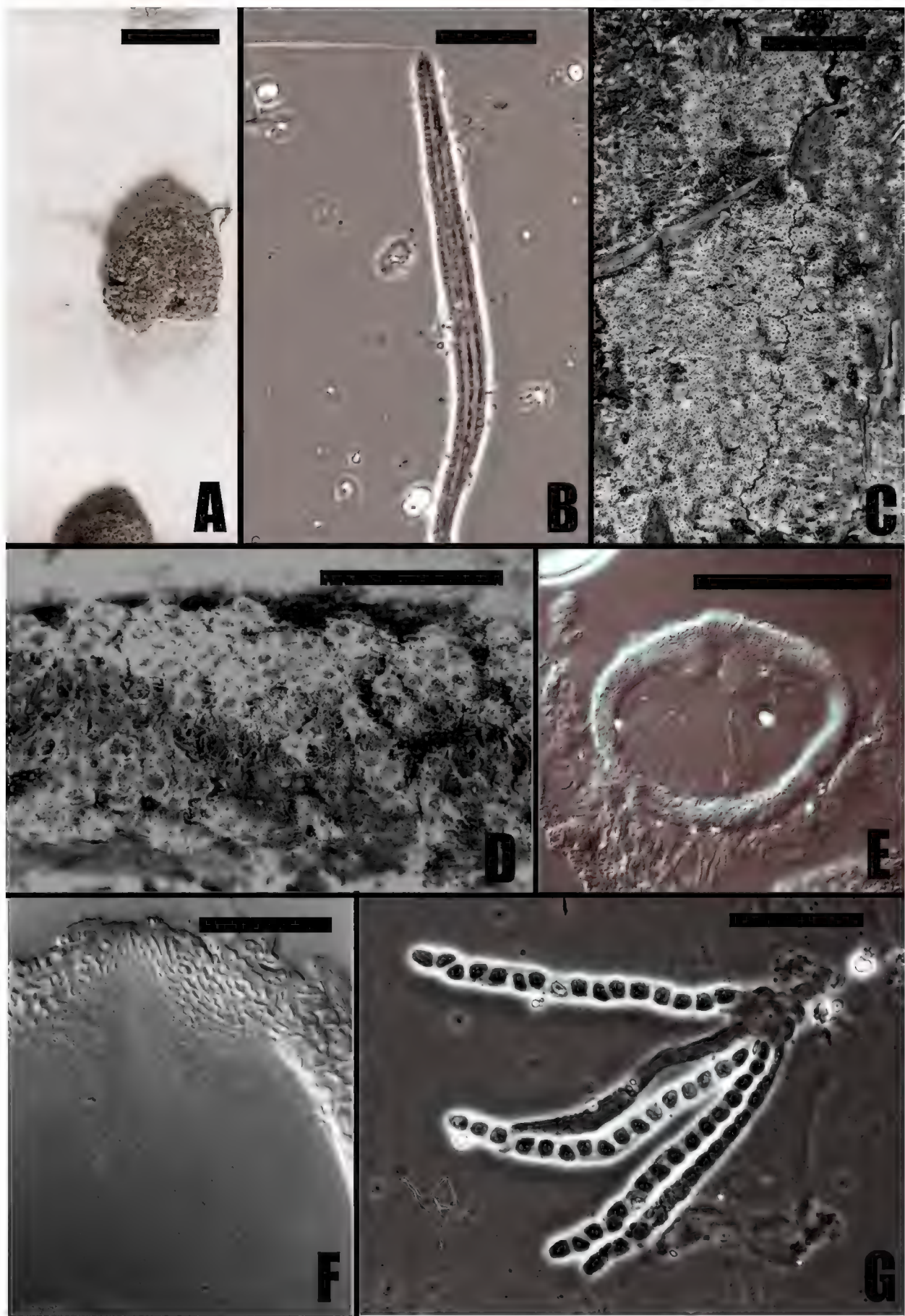


FIG 5. A, B. *Hypocrea discoidea*. A. Stroma. B. Ascus and ascospores. Type. C–G. *H. farinosa*. C, D. Perithecia semi immersed in a subiculum. E, F. Sections through mature perithecia showing wall anatomy. G. Asci and ascospores. Type. Scale bars: A, C = 2 mm, B = 10 μ m, D = 1 mm, E = 100 μ m, G, F = 20 μ m.

The concept of *Protocrea* Petch and its type species, *P. farinosa*, has been confused (Doi 1972, Overton & al. 2006b). Jaklitsch & al. (2008) restricted the genus to fungicolous species having gliocladium-like anamorphs and proposed a new epitype for *H. farinosa*, overturning the epitypification proposed by Overton & al. (2006b). The phylogenetic analysis proposed by Jaklitsch & al. (2008) placed *P. farinosa* outside of *Trichoderma* but, despite morphological similarity and fungicolous habit, it is also distinct from the type species of *Gliocladium* Corda, *G. penicillioides* Corda, the anamorph of *Sphaerostilbella aureonitens* (Tul. & C. Tul.) Seifert & al. (Seifert 1985).

Hypocrea fendleri Berk. & M.A. Curtis in Cooke, Grevillea 12: 80. 1884.

Type: Venezuela, 223 (K, herb Berk. 1879!). HOLOTYPE.

Observations: The type specimen of *H. fendleri* consists of a stiff piece of paper with a piece of very rotten wood glued to it. A possible corticioid basidiomycete is present on the specimen along with thin, arachnoid, white mycelium growing over its surface. There is no evident hypocrea stroma present on the specimen.

Commentary: Cooke (1884) described this species from a specimen that he found in Berkeley's herbarium (number 8325). Cooke's description follows:

"Sub-effusa, plana, demum atro-fusca, margine obtuso, contextu albo. Peritheciis immersus, subglobosis. Ascis cylindratis, octosporis. Sporidiis ellipticis, hyalinis (.005–.006 mm. long)."

Dennis (1970) commented that the species "was based on an unrecognizable fragment," consistent with my observation. The identity of *H. fendleri* is unknown.

Hypocrea flavovirens Berk., in Cooke, Grevillea 12: 100. 1884. Fig. 6 A–E
= ***Trichoderma catoptron*** Chaverri & Samuels, Stud. Mycol. 48: 43. 2003,
nom cons prop. (Samuels 2014).

Type: [India], Wellington, Nielgherries, Oct (K, herb. Berk. 1879!). HOLOTYPE.

Observations: The type specimen consists of a piece of thick bark glued to a piece of paper. Stromata scattered, discrete, turbinate to cylindrical, 1.0–1.5 mm diam, larger stromata with ca. 50 perithecia, with a broad, sterile base; stroma surface broadly tuberculate, pale yellow, ostiolar openings appearing as green dots from discharged ascospores; not changing color in 3% KOH. Most stromata collapsed, internal tissue degenerated. No differentiated surface layer; cells of the stroma surface circular to angular, 5–10 µm diam,

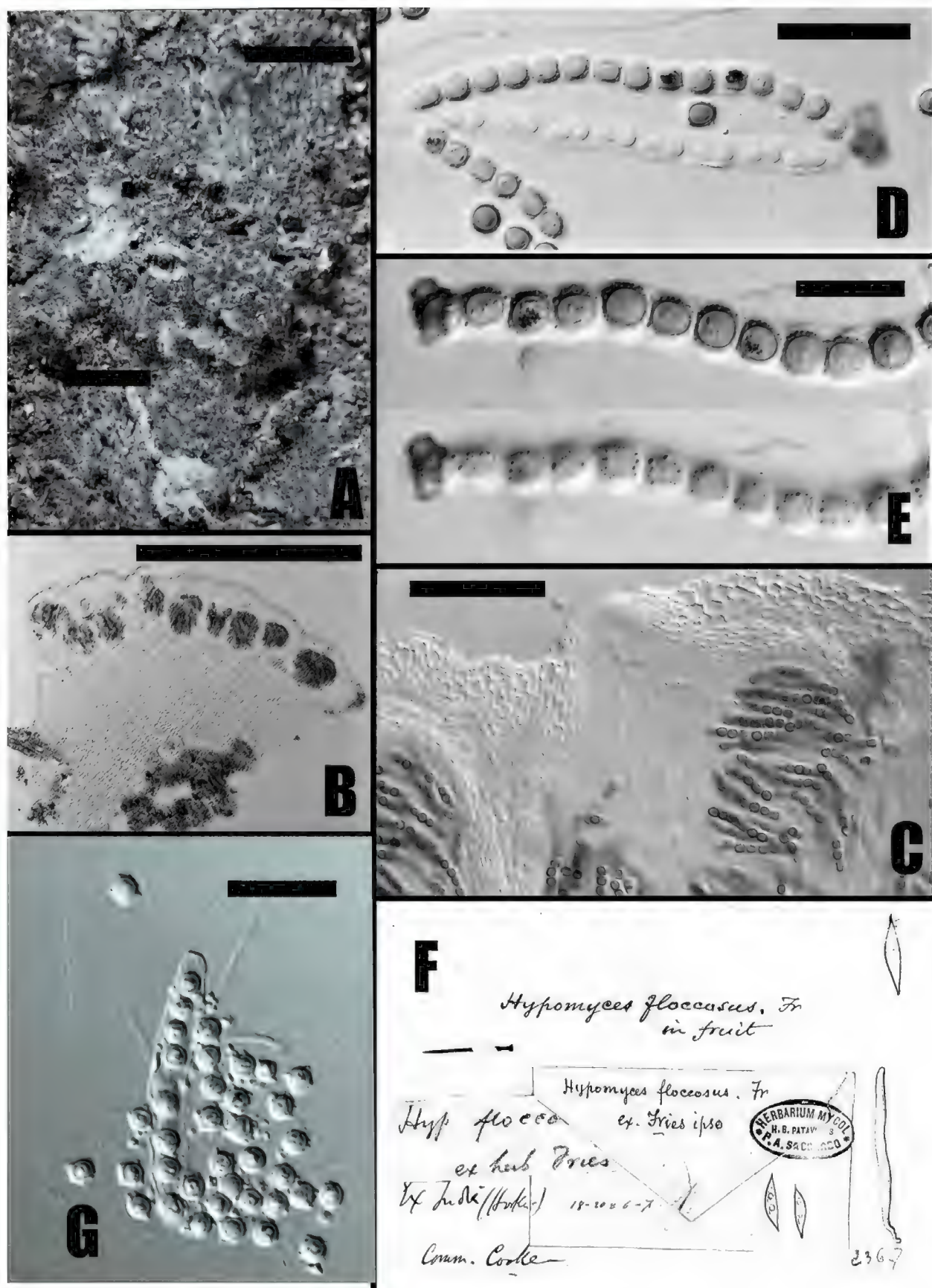


FIG 6. A – E. *Hypocrea flavovirens*. A. Stromata, B. Section through a stroma with mature perithecia. C. Section through a mature perithecium showing the papilla. D. Ascus and ascospores. E. Asci and ascospores, above in surface view, below in optical section. Type. F. *Hypocrea floccosa*. Packet from Saccardo's herbarium with a packet from Fries' herbarium with a drawing of ascospores. G. *H. inclusa*. Ascus and ascospores. Type. Scale bars: A = 2 mm; B = 0.5 mm, C, H = 50 μ m, D = 20 μ m, E – G = 10 μ m.

walls not conspicuously thickened, continuous between perithecia. Perithecia subglobose in section, 210–350 µm tall, 150–190 µm wide, ostiolar canal 60–100 µm long; perithecial opening formed of narrow hyphal elements protruding through the stroma surface. Asci (n = 30) cylindrical, (77–)82–100(–110) × (4.5–)5.5–7.5(–8.0) µm, apex thickened, with a pore. Ascospores (30) green, coarsely warted, walls conspicuously thickened, dimorphic to monomorphic; distal part-ascospores globose to subglobose, (4.5–)5.2–6.0(–6.5) × (4.5–)4.7–5.5(–5.7) µm; proximal part-ascospores broadly wedge-shaped to subglobose, 5.0–6.0(–7.2) × (3.7–)4.2–5.0(–8.0) µm.

Commentary: Cooke (1884) described this species based on material found in Berkeley's herbarium (no. 8305), attributing the species to Berkeley. Chaverri & Samuels (2003) redescribed the species. Samuels (2014) proposed conservation of *T. catoptron* over the older epithets *H. sulfurella* and *H. flavovirens*.

Hypocrea floccosa Fr., Summa Veg. Scand. 2 p. 564. 1849, *nom. nud.* Fig. 6 G

= *Hypomyces floccosus* Sacc., Syll. Fung. 2: 472. 1883.

= ? *Hypomyces lateritius* (Fr.) Tul. & C. Tul., Ann. Sci. Nat. Bot., Sér. iv, 13: 11. 1860.

Type: [India], Pomrang, Sep 18 1850 (K)! HOLOTYPE of *Hypomyces floccosus*.

Commentary: The connection of this name to Berkeley is tenuous. I include it here for completeness. Fries (1849: 564) reported the new species '*H. floccosa*' on *Lactarius torminosus* near Uppsala without description or reference to a description:

“Una cum Hymenomycetibus hoc anno mire luxuriabant *Hypocreae* *Hypomyces* v.c. *H. lateritia*, *viridis...hyalina* — et novae *H. atra* (Agaricicola?) et *floccosa* in *Lactario torminoso*. — Nova quoque Hyperrhizae species Upasaliae lecta.”

Berkeley (1854: 226) reported *Hypocrea floccosa* Fr., but from India and again without a description. The first description of the species comes from Saccardo (Syll. Fung. 2: 472. 1883). He described *Hypomyces floccosus* with *Hypocrea floccosa* Fr. in Berk. as a synonym, based on the Hooker collection of *Hypocrea floccosa* reported on by Berkeley. Saccardo, in his description of *Hypomyces floccosus*, indicated that M.C. Cooke had provided him with Friesian material but Saccardo wrote that he was unable to observe any details in the Fries collection (“ex quo naturam subiculi extricari non potui”), despite

there being what appear to be drawings of two ascospores of a *Hypomyces* species, with measurements, on the packet in PAD. Saccardo attributed the species to Fries *in herb*, while reporting the habitat as India and describing an Indian collection.

Two specimens were examined for the present work, one from Berkeley and one from Fries via Saccardo. Saccardo's specimen (Fig. 6 G) of *Hypocrea floccosa* comprises a card with a small packet glued to it and labeled '*Hypomyces floccosus* Fr. ex Fries ipse.' An annotation on that packet, in a different hand is "*Hyp. Floccosa* ex herb. Fries." A further annotation on the card is 'ex Ind[ia] (Hooker). Comm. Cooke.' On the card itself there is the drawing of a unicellular, biapiculate ascospore – possibly of a *Hypomyces* species – and an empty ascus. Two unicellular, biapiculate spores are drawn on the small packet with measurements '18–20 × 6–7.' I did not observe asci or ascospores in the specimen that was in the small packet. I did not find any other collections of *Hypocrea floccosa* in Saccardo's collection, despite the fact that he provided measurements in the description of the species.

The Berkeley (K) specimen of *Hypocrea floccosa* Fr. that was reported by Berkeley (1854) was collected in India in 1850. This is the specimen upon which Saccardo based his description of *Hypomyces floccosus*. Perithecia in this specimen are crowded on the cap surface (gills not visible) and stipe of a small mushroom, not reacting to KOH; one perithecium was 320 µm high, 240 µm wide. Ascospores were elliptic–fusiform to rarely slightly clavate, (13.7–)14.5–17.5(–18.7) × 4.5–5.7(–6.7) µm, finely spinulose; ends with an apiculus 1.5–2.2 µm long or non apiculate, obtuse, hyaline.

It is questionable whether the Indian/Hooker specimen is the same species as the Fries' collection from Sweden. Based on the drawings of ascospores on the packet the Saccardo received from Fries and my own observations of the Hooker collection, and the fact that perithecia in the Hooker collection have formed on a mushroom, there is no doubt that both represent species of *Hypomyces* and not *Hypocrea/Trichoderma*. There is no question that Saccardo described a species from India as *Hypomyces floccosus*. For that reason the Indian collection must be taken as the type of the species of which Saccardo alone is the author. Whether Saccardo misapplied Fries' name is beyond the scope of this work. Saccardo questioned whether *Hypomyces floccosus* could be distinguished from *Hypomyces torminosus* (Durieu & Mont.) Tul. & C. Tul.

The name *Hypomyces torminosus* is confused and probably has been misapplied. Rogerson & Samuels (1994) discussed the species and its

relationship to two other *Lactarius*-inhabiting species with unicellular ascospores: *Hyp. lateritius* (Fr.) Tul. & C. Tul. and *Hyp. lithuanicus* Heinr.-Norm. Following that discussion, it is likely that *Hyp. floccosus* is a later name for *Hyp. lateritius*.

Hypocrea fusigera Berk. & Broome, J. Linn. Soc. Bot. 14: 112. 1873.

≡ *Protocreopsis fusigera* (Berk. & Broome) Yoshim. Doi, Bull. Natl. Sci. Mus. Tokyo, Ser. B, 4: 119. 1978.

≡ *Clintoniella fusigera* (Berk. & Broome) Petch, Ann. Roy. Bot. Gard. Peradeniya 7: 112. 1920.

= *Nectria subfalcata* Henn., Hedwigia 41: 4. 1902.

= *Hypocrea bromeliicola* Bat. & al [as 'bromellicola'], Sydowia Beih 1: 322. 1957.

≡ *Nectria bromeliicola* (Bat. & al.) Samuels, Mem. New York Bot. Gard. 26(3): 32. 1976.

≡ *Protocreopsis bromeliicola* (Bat. & al.) Yoshim. Doi., Bull. Natl. Sci. Mus., Tokyo, Ser. B, 4: 118. 1978.

= *Nectria heliconiae* E. Müll. & Dennis, Kew Bull. 19: 383. 1965.

= *Protocreopsis musicola* Yoshim. Doi., Bull. Natl. Sci. Mus., Tokyo, Ser. B, 2: 129. 1976.

= *Protocreopsis zingibericola* Yoshim. Doi., Kew Bull. 31: 552. 1976[1977]. Type: Ceylon, 44, on monocot (K, herb Broome!). HOLOTYPE.

Observations: The holotype consists of a few fragments of a monocot leaf glued to a piece of paper. There are drawings of two ascospores and one ascus on the label. Perithecia are typical of this common tropical species. A microscopic preparation of the type was not made.

Commentary: *Protocreopsis fusigera* was redescribed by Doi (1978, under various names), Samuels (1976) and Rossman *et al.* (1999). Its acremonium-like anamorph with large, thick-walled, fusiform conidia was illustrated by Samuels *et al.* (1990). This species is common on leaves of monocotyledonous plants and wood and is pantropical in distribution.

Hypocrea grossa Berk., in Hooker's J. Bot. Kew Gard. Misc. 3: 206. 1851 (basionym).

≡ *Podocrea grossa* (Berk.) Lloyd, Mycol. Writ. 7: 1259. 1924.

≡ *Podostroma grossum* (Berk.) Boedijn, Bull. Jard. Bot. Buitenzorg, ser. 3, 13: 273. 1934.

≡ *Trichoderma grossum* (Berk.) Samuels, **comb. nov.** IF 901690

Type: '*Hypocrea grossa*, Berk. No. 99, Sikkim (K!). HOLOTYPE.

Observations: The holotype specimen consists of one stroma with a tuberous base glued to a stiff piece of paper. The stroma is spatulate, with a few broad, flat lobes above, the largest measuring 40 mm tall $\times$ 17 mm at the widest point, yellow–brown, no visible perithecia. No asci or ascospores were seen. A mould (not *Trichoderma*) appears to grow over the surface of the stroma.

Commentary: Berkeley (1851, p. 206) provided the following description of his new species:

'Inodorous. Receptacle 2 inches high, $\frac{3}{4}$ inch thick, below, springing from a tuberous base, erect, clavate, divided above into short obtuse lobes, externally of an opaque vermilion which fades in the dry specimens to a pale reddish–brown. Substance pale yellow, dry, and somewhat coriaceous. Perithecia irregular, confluent. Unfortunately, the sporidia are imperfect, but so far as could be ascertained they appear to be minute, colorless, and elliptic. One of the most curious species in the collection.'

Chamberlain & al. (2004) rejected *Podostroma* and described or redescribed several species, including *H. grossa*. Their redescription was based mainly on recent collections from Japan and Thailand that they identified as *H. grossa*. The closest morphological comparison is with *Trichoderma cornu–damae* (Pat.) Z.X. Zhu & W.Y. Zhuang ($\equiv$ *H. cornu–damae* Pat., see Chamberlain & al. 2004). Whether the species concept adopted by Chamberlain et al. (2004) accurately reflects the species described by Berkeley can only be proven through study of additional collections originating in Sikkim. However, I have no doubt that the fungus described as *H. grossa* by Berkeley is a species of *Trichoderma*.

Hypocrea inclusa Berk. & Broome, Ann. Mag. Nat. Hist., ser. iii, 7: 449–451. 1861. Fig. 6 F, G

$\equiv$ *Battarrina inclusa* (Berk. & Broome) Clem. & Shear, Gen. Fung. p. 279.1931.

Type: '*Hypocrea inclusa* B. & Br., N. Bristol, Nov. 18659, from C.E. Broome 2335 (K(m) 48951, ex herb. William Phillips!). HOLOTYPE.

Observations: The holotype consists of a flat section of the ascoma of a *Tuber* species glued to a piece of paper. The specimen is in poor condition and perithecia were not observed. However, asci of the *Battarrina* appear to fill 'lacunae' in the hymenium of the *Tuber*. Asci are cylindrical, with a simple apex; most contain 8 ascospores. Ascospores are subglobose to slightly angular, $3.7\text{--}4.5 \times 3.5\text{--}5.0 \mu\text{m}$, with scattered, ca. $1 \mu\text{m}$ tall echinulations.

Commentary: *Battarrina inclusa* is the type species of *Battarrina* (Sacc.) Clem., a genus of the *Bionectriaceae*. Rossman & al. (1999) studied two additional collections of this species, both of which were in poor condition, and provided a description based in part on descriptions and illustrations published by Hawker (1955) and Petch (1938).

Hypocrea insignis Berk. & M.A. Curtis, in Berkeley, J. Linn. Soc. Bot. 10: 376. 1869. Fig. 7 A–E

≡ *Trichoderma neoinsigne* Samuels, **nom. nov.** IF 901692 (non *Trichoderma insigne* Z.F. Yu & X. Du, in Zheng & al., Journal of Fungi 7 (6, no. 467): 22. 2021).

Type: “516. *Hypocrea insignis*, B. & C. Cuba, Wright (Curtis) (K, herb. Berkeley!) HOLOTYPE. “Fungi Cubensis Wrightiani No. 755. *Hypocrea insignis* Berk. & Curt. Coll. Wright [516? added later] (FH, Gray herbarium!) ISOTYPE.

Observations: The holotype specimen consists of two fragments of bark glued to a piece of paper; there are two stromata on each piece of bark. Stromata discoidal, 4–6 mm diam, 1–1.5 mm high, margins free, brownish orange to pale yellow, red–orange in 3% KOH, surface plane, perithecial elevations not evident, perithecial openings appearing as minute amber dots against a lighter background.

The following observations are taken from the isotype collection.

Cells of the stroma surface indefinite in outline, in part appearing hyphal, thick-walled, at most 5–7 μm wide. In section the stroma surface region 15–25 μm wide, comprising densely interwoven hyphae, cells < 5 μm diam. Tissue below the stroma surface between perithecia loosely interwoven hyphae, ca. 5 μm wide. Internal tissue below perithecia densely interwoven, thick-walled (ca. 1.5 μm), 6–7 μm wide hyphae. Perithecia elliptic in section, 250–270 μm tall, 100–120 μm wide, ostiolar canal 60–75 μm long; cells of the perithecial opening not clavate, not anatomically distinct from the cells of the surrounding stroma surface. Asci ($n = 10$) cylindrical, 65–90 $\times$ (3.5–)4–5 μm , apex apparently simple. Ascospores ($n = 11$) hyaline, ultimately spinulose, dimorphic; distal part-ascospores globose to subglobose, 2.5–3.5(–4.0) $\times$ 2.2–2.5 μm ; proximal part-ascospores oblong to narrowly wedge-shaped, 3.2–3.5(–4.7) $\times$ 2.0–2.2 μm .

Commentary: *Trichoderma neoinsigne* is published as an explicit substitute (“nom. nov.”) for the legitimate name *Hypocrea insignis* Berk. & M.A. Curtis because the epithet *insigne* is unavailable in *Trichoderma* due to *Trichoderma insigne* Z.F. Yu & X. Du.

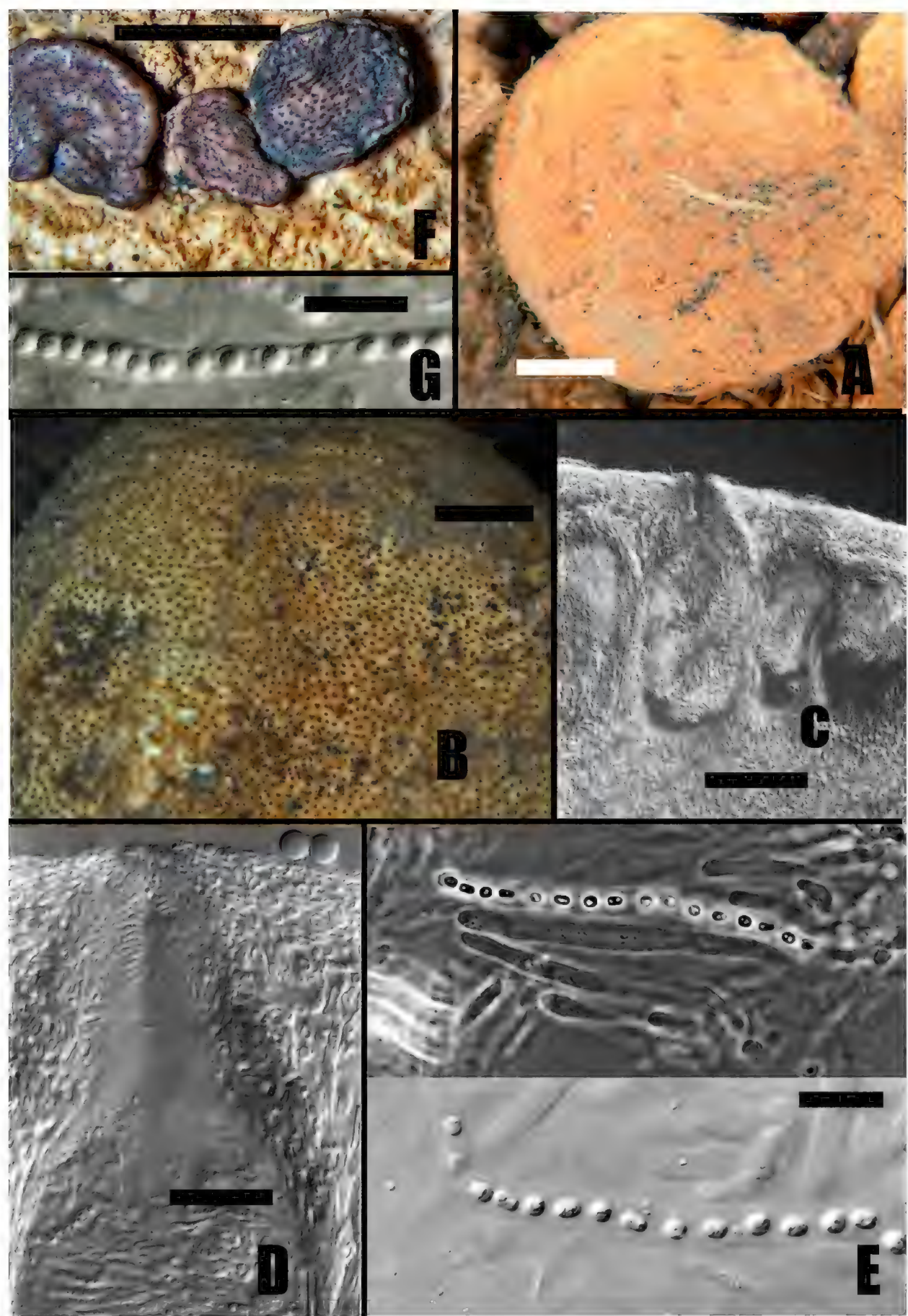


FIG 7 A – E. *Hypocrea insignis*. A. Stroma. B. Stroma surface, showing perithecial openings. C, D. Sections through perithecia. Ostiolar area shown in D. E. Asci. *Fungi cubensis* 735. F, G. *Hypocrea jecorina*. F. Stroma. G. Ascus showing monomorphic–globose part ascospores. Type. Scale bars: A = 0.5 mm; B = 0.25 mm; C = 100 μ m; D = 50 μ m; E, G = 20 μ m; F = 3 mm.

Because the holotype and isotype collections are macroscopically identical a microscopic preparation was not made from the holotype. The species is distinctive for its pale–yellow stromata that become red in KOH, and the numerous perithecia in each stroma. Patouillard (1902) reported the species from Guadeloupe and Lloyd (1924) reported the species from Uganda. It is difficult to speculate as to the relationships of the species. Based on the stromata alone, *T. neoinsigne* is most likely not a member of the Viride Clade (see Jaklitsch & al., 2006). In the characters of the stroma, including orange coloration, relatively large dimension, discoidal form and large number of perithecia *T. neoinsigne* suggests the tropical *Trichoderma pezizoides* (Berk. & Broome) Jaklitsch & Voglmayr.

Hypocrea jecorina Berk. & Broome, J. Linn. Soc. Bot. 14: 112. 3 Dec 1873.
Fig. 7 F, G

= *Trichoderma reesei* E.G. Simmons, Abstr. Second International Mycological Congress Vol. M–Z. p. 618. 1977. Nom. Cons. Prop.

= *Hypocrea borneensis* H.S. Yates, Philippine J. Sci. C, Bot. 13: 237. July 1918.

Type: “33. *Hypocrea jecorina*, B. & Br., Peradeniya, G.H.K.T., Nov. 1867” (K, herb. Berkeley!). HOLOTYPE

Observations: The type consists of two fragments of decorticated wood glued to a piece of paper and a drawing of two asci and several ascospores. Stromata discrete but crowded with margins of individual stromata overlapping, flat, discoidal, 1–3 mm diam, brown, not changing color in 3% KOH, broadly attached, margins free, sometimes scalloped, ostiolar openings black, appearing as minute cracks in the stroma surface, surface plane, perithecial elevations not evident. Cells at the stroma surface, in face view, indistinct. Stroma surface in section 25–40 µm thick, formed of short-celled hyphae 3–5 µm diam, pigmented cells with walls ca. 0.5 µm wide. Tissue immediately below the stroma surface, between perithecia, formed of loosely interwoven, ca. 3 µm wide hyphae. Tissue of stroma below perithecia pseudoparenchymatous with many long hyphal elements up to 6 µm wide and circular cells up to 7 µm diam, walls ca. 1.5 µm thick. Perithecia crowded, tending to be ellipsoidal in section, 135–165 µm tall, 90–135 µm wide, ostiolar canal 60–80 µm long; ostiolar opening not sharply distinguished from surrounding stroma tissue, becoming green in lactic acid. Asci cylindrical, 60–65 × 5–6 µm, apex thickened, with a pore, ascospores becoming diagonally disposed. Ascospores hyaline, spinulose to warted, monomorphic, globose to subglobose, 3–4 µm diam.

Commentary: The description of stroma anatomy given here is drawn from a composite of the species (Samuels & al. 1998). The anamorph of *H. jecorina* is *T. reesei* (Kuhls & al. 1996; Samuels & al. 1998), a species that is well-known for its commercial production of cellulose enzymes. Although the name *T. reesei* is much younger than *H. jecorina* its conservation over the former has been proposed (Samuels 2014) because the latter name dominates the literature. The anamorph was originally described from the Solomon Islands but has since been isolated directly from soil in French Guiana (Lieckfeldt & al. 2000). *Trichoderma reesei* is a member of the Longibrachiatum clade (Samuels & al. 2012b).

Hypocrea laetior Berk. & M.A. Curtis, in Berkeley, J. Linn. Soc. Bot. 10: 376. 1868[1869] (basionym). 8 Fig. A–D

= *Trichoderma laetioris* (Berk & M.A. Curtis) Samuels, **comb nov.** IF 901691

Type: “518 *Hypocrea laetior* B & C Cuba (Wright) Curtis (K, Herb. Berkeley!). LECTOTYPE IF 901984, *hic designatus*

Isotypes: “*Hypocrea laetior* B & C, Cuba, [s.n.] ex herb. Cooke” (K). “*Hypocrea laetior*, B & C. rotten logs, Cuba, Dec, C. Wright (518)” (FH, Herb. Curtis!).

Observations: The original gathering was divided into three parts, one sent to Berkeley (K) and one kept by M.A. Curtis (FH). The third part, consisting of a single stroma on a piece of decorticated wood, is preserved in the Cooke herbarium (K). The parts are apparently identical; internal tissue of the stroma is disintegrated. The Berkeley portion, which is here designated as lectotype, consists of one piece of decorticated wood with a single stroma that has been cut. The Curtis portion consists of a single piece of wood with two stromata. Stromata discoidal, 3–5 mm diam, 0.5–1 mm high, broadly attached, margins free, light brown to brownish–orange, red in 3% KOH, yellow in lactic acid; surface slightly wrinkled, perithecial elevations appearing as low, broad tubercles, the perithecial opening a conspicuous dark brown spot in the middle of the elevation. Cells of the stromal surface in face view distinctly angular or circular, 7–15 µm diam, walls ca. 1.5 µm thick. Stroma surface region, in section, ca. 25 µm wide, cells circular to angular, ca. 7.5 µm diam, walls ca. 1.5 µm thick, pigmented, this region continuous around the top and bottom of the stroma. Region below the surface and between perithecia formed of loosely intertwined, colorless, thin-walled hyphae. Internal stroma tissue below perithecia disintegrated. Perithecial apex not sharply differentiated from

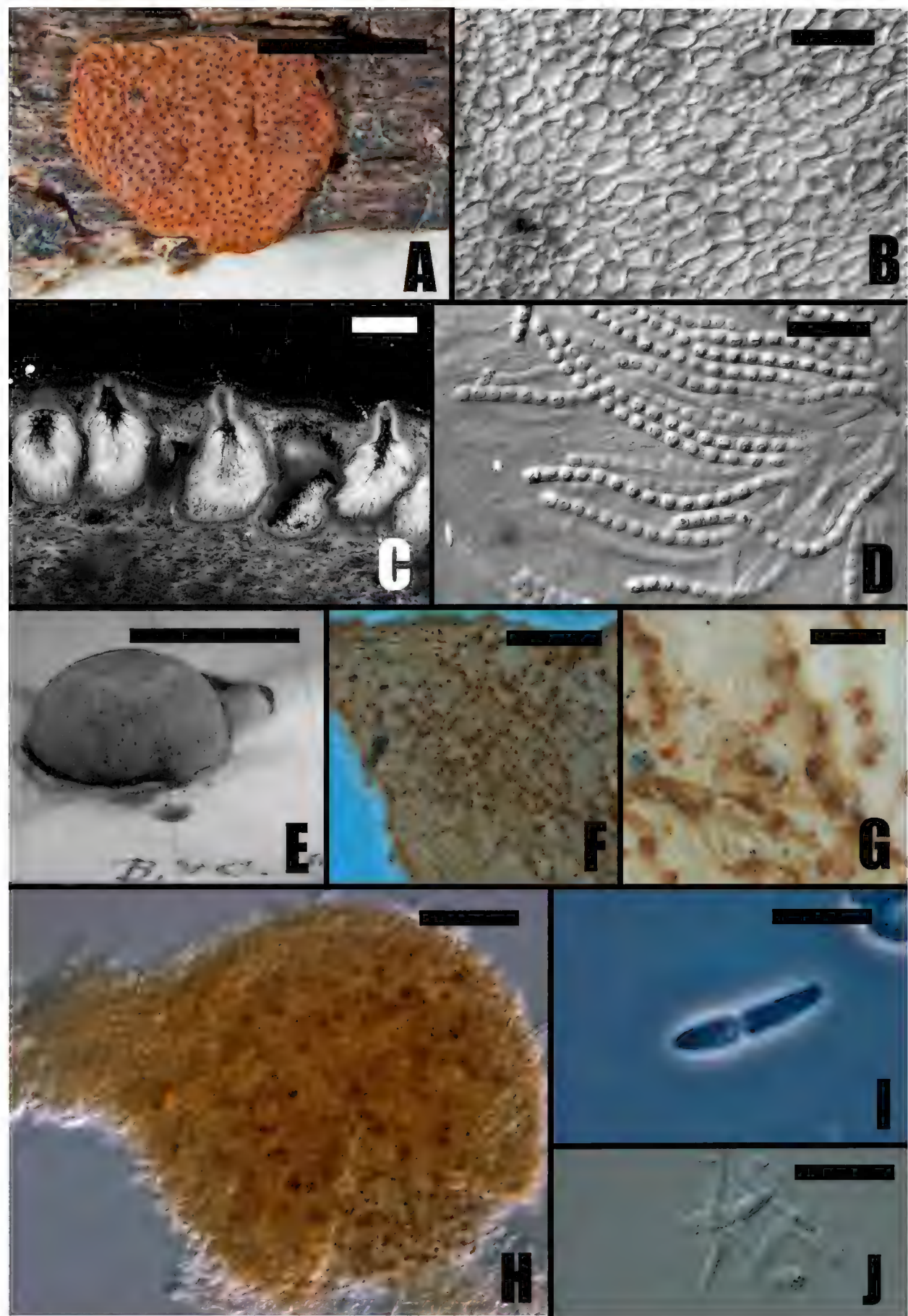


FIG 8. A–D. *Hypocrea laetior*. A. Stroma. B. Cells at the surface of the stroma in face view. C. Section through a stroma showing mature perithecia. D. Asci and ascospores. Type (K). E. *H. maculaeformis*, stroma. Isotype, FH. F–J. *H. membranacea*. F, G. Perithecia immersed in a white subiculum. H. A perithecium. I, J. Ascospores. In J ascospores are germinating. Type. Scale bars: A = 2 mm, B, D, H = 20 μ m; C = 100 μ m, E = 15 mm, F = 1 mm, G = 500 μ m; I, J = 10 μ m.

the surrounding stroma tissue. Perithecia elliptic in section, crowded, 250–270 μm tall, 135–180 μm wide, ostiolar canal ca. 75 μm long. Asci cylindrical, 70–95 $\times$ 5–6 μm , apex apparently simple, ascospores uniseriate. Part-ascospores hyaline at first, becoming yellow and then markedly spinulose, monomorphic, subglobose to globose, 4.2–5.0 $\times$ 4.0–4.5 μm .

Commentary: The description of the anatomy is taken from the FH portion.

The combined attributes of discoidal, orange-brown stromata that are red in KOH, the conspicuous, punctate perithecial openings, the distinctly angular cells of the stroma surface and the yellow ascospores characterize this species. Apparently, this species has not been recollected. A second specimen identified as *H. laetior* [“*Hypocrea laetior* on stems in the woods, July, [Cuba handwritten later], 878 (K, Herb. Berk. 1879!)”] was not cited in the protologue and apparently is not this species. *Hypocrea laetior* is morphologically very similar to *H. patella* Cooke & Peck (Dodd & al. 2002) and the two species may be found to be synonyms. Although the stroma surface of *H. patella* is red in KOH, its ascospores are not yellow and its stromata are typically crowded; moreover, *H. patella* is a species of north temperate regions (Austria, USA: IN, KY, NC, NY) whereas *H. laetior* was described from Cuba. For these reasons I accept both species

Hypocrea maculiformis Berk. & M.A. Curtis, in Berkeley, J. Linn. Soc. Bot. 10: 376. 1868[1869] (basionym). Fig. 8 E

$\equiv$ *Ascopolyporus maculiformis* (Berk. & M.A. Curtis) Samuels, **comb. nov.** IF 901693.

= *Ascopolyporus polychrous* Möller Phycom. & Ascom. 300. 1901.

Type: “767 *Hypocrea maculiformis*, B & C, Cuba, Wright, Curtis” (K!). LECTOTYPE *hic designatus*. IF 901694

Isotype: “*Hypocrea maculiformis* B&C, Cuba, C. Wright (767), Fung. Cub. 757 [sic.]” (FH: Herb. Curtis!).

Observations: Type material of *H. maculiformis* appears to consist of a single, globose stroma that has been cut into two and without any indication of a host or substratum. The portion in Berkeley’s herbarium (K) is hemispherical, 18 mm diam, ca. 10 mm tall, in part golden and in part brownish; the stroma surface of the gold part is furfuraceous, not reacting to 3% KOH. Perithecia are completely immersed, numerous. Asci are long, cylindrical and have a massive cap. Ascospores are filiform, multiseptate, disarticulating into oblong part-ascospores. The portion in Curtis’ herbarium (FH: Herb. Curtis) appears to be the other half of the stroma. It appears to be mostly sterile but for one part of the surface in which perithecia are immersed; perithecia are devoid of asci.

Commentary: Seaver (1910) considered *H. maculiformis* to be a doubtful species of *Hypocrea* based on its description. The type material of *H. maculiformis* agrees well with the original description and illustrations of *A. polychrous* (Möller 1901). Because *Hypocrea maculiformis* 1868 is the older epithet, it takes precedence in *Ascopolyporus* if the synonymy is accepted. The species is illustrated by Doi & al. (1977) and Hernández & al. (2001). Möller (1901) illustrated an acremonium-like anamorph for the species.

Hypocrea membranacea Berk. & Broome, Trans. Linn. Soc. London Bot., ser. 2, 2: 70. 1883 non Henn. 1897. Fig. 8 F–J

= *Sporophagomyces chrysostomus* (Berk. & Broome) K. Pöldmaa & Samuels, Canad. J. Bot. 77: 1765. 1999[2000].

≡ *Hypomyces chrysostomus* Berk. & Broome, J. Linn. Soc. Bot. 14: 113. 1873[1875].

= *Acremonium lindtneri* (Kirschst.) Samuels & Rogerson, Mycologia 85: 248. 1993.

≡ *Septocylindrium lindtneri* Kirschst., Z. Pilzk. 15: 118. 1936.

Type: “*Hypocrea membranacea* B et Br, Brisbane, No 181, F.M. Bailey” (K, herb. C.E. Broome!). HOLOTYPE.

Observations: The holotype specimen consists of two pieces of a polypore with a thick pore surface glued to a piece of stiff paper, and a small packet with a very thin membranous structure. The membranous structure is hyphal and light ochre but darker in part; there are neither perithecia nor conidia on this structure. The pieces of the polypore have fragments of the membranous material attached. Perithecia are numerous, semi immersed in the hyphae, amber in color, pyriform with a short papilla, 250 µm tall, 80 µm wide (one measured). No asci were seen. Ascospores are discharged, 12.5–15.5 × 3.0–3.5 µm, bicellular, disarticulating after discharge at the septum; the part ascospores monomorphic and fusiform or dimorphic, the part-ascospores wedge-shaped but one part longer than the other.

Commentary: *Hypocrea membranacea* was described from material collected in Australia (Queensland). Even though the type specimen is overmature, there is no doubt that this species is the common, widespread *Sporophagomyces chrysostomus* that is better known as *Hypomyces chrysostomus* (Rogerson & Samuels 1993). The membranous material is typical of *S. chrysostomus*; it appears in the form of an easily removed fan on the pore surface of ganodermataceous polypores. At first it is white but as spores are discharged by the polypore, they are trapped in the fan, which

then becomes brown. The acremonium-like anamorph forms profusely in the membranous structure. Conidia are cylindrical, (9.5–)11.5–20.0(–27.5) $\times$ 2–4(–5) μm , 1-septate, hyaline. Rogerson & Samuels (1999) redescribed and illustrated the species (as *Hypomyces chrysostomus*). The genus *Sporophagomyces* K. Pöldmaa & Samuels (Pöldmaa & Samuels. 1999) was proposed to accommodate hypomyces-like species that occur on polypores and that have bicellular ascospores that disarticulate after discharge from asci.

Hypocrea multiformis Berk. & Broome, J. Linn. Soc. Bot. 14: 112. 3 Dec 1873 (basionym), non Cesati ex Sacc. 1886. Fig. 9 A–G

$\equiv$ *Trichoderma multiforme* (Berk. & Broome) Samuels, **comb. nov.** IF 901695

Type. “1095 *Hypocrea multiformis* B. & Br.” (K!). LECTOTYPE *hic designatus* IF 901706

Typification: Four syntypes (1094, 1095, 1096, 33 *in part*) were cited in the protologue of this species; a lectotype has not been selected. Three of the four collections were made on a different date; all were collected in Ceylon (Sri Lanka). All are preserved in Berkeley's herbarium (K). Based on the study of the four specimens at least three species are represented. The specimens are described as follows.

1095.

This specimen has been divided into four parts. Two parts have pieces of decorticated wood glued to paper and are hand-labeled as (1) 1095 *Hypocrea multiformis* B. & Br., (2) “1095(portion) *Hypocrea multiformis* B & Br Cent. Prov. Dec 1868.” This is annotated by an unidentified person “A *Chromocrea* with warted olive spores 6–7 $\times$ 5 μ ,” (3) “*Hypocrea multiformis* B & BR ! Ceylon 1095,” (4) *Hypocrea multiformis* B & Br” Annotated by an unidentified person “Hardly quite ripe but shewing [sic] the usual fruit of the genus.” Parts 3 and 4 are in small packets from the herbarium of F. Currey; they are apparently identical to part 1.

Part 1. 1095 *Hypocrea multiformis* B. & Br. Fig. 9 A, B, Lectotype

This portion contains stromata of a species of *Trichoderma* having white (colorless) ascospores. Stromata abundant, circular in outline, 0.5–1.0 mm diam, tan or light brown, scattered, discrete, slightly convex; margins free, scalloped; not reacting to 3% KOH. Perithecial elevations separated by shallow grooves, appearing as low tubercles. Perithecial openings appearing as dark, areolate spots. Cells of the stroma surface circular to angular, ca. 10 μm diam, walls ca. 1 μm thick. Perithecia subglobose in section, 220–280 μm tall, 125–

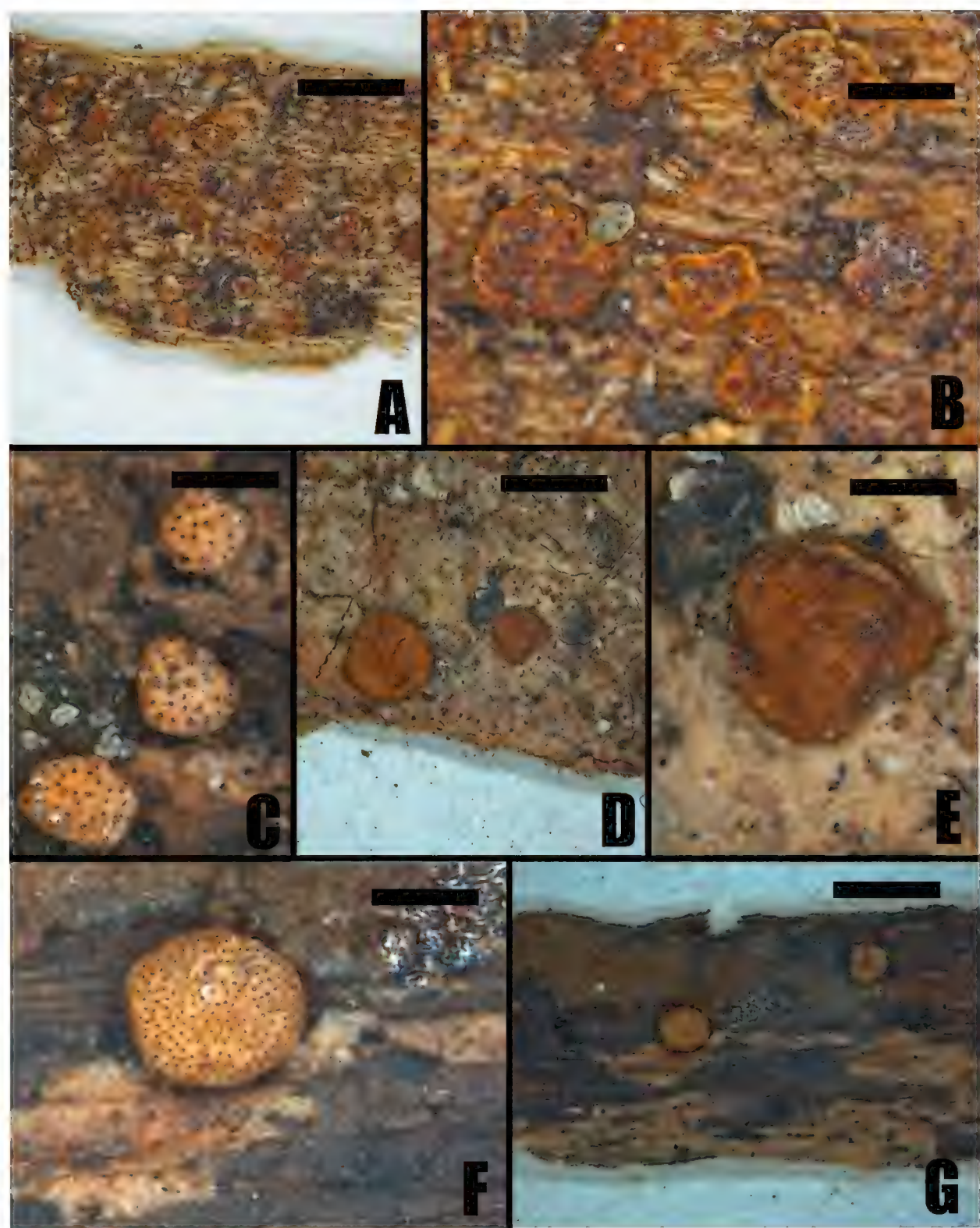


FIG 9. A–G. *Hypocrea multiformis*, stromata. A, B from 1095 (lectotype). C from 1094. D, E from 33. F, G from 1096. Scale bars: A, G = 10 mm, B–D = 2 mm, E, F = 1 mm.

197 μm wide, ostiolar canal 65–90 μm long. Cells of the perithecial apex not clavate, not sharply distinguished from cells of the surrounding stroma surface. Asci cylindrical, (52–)60–70(–75) $\times$ (2.7–)3.5–5.0(–5.5) μm , apex with a thin ring, ascospores uniseriate. Part-ascospores hyaline, smooth to slightly warted, dimorphic; distal part subglobose to broadly conical, (2.5–)3.0–3.7(–4.2) $\times$ (2.2–)2.5–3.2(–3.5) μm ; proximal part wedge-shaped to oblong, (3.0–)3.2–4.0(–4.7) $\times$ (2.0–)2.2–2.7(–3.0) μm .

Part 2 has a green-ascospored *Trichoderma* as well as a small stromal, white-ascospored *Trichoderma* that looks like the *Trichoderma* on part 1. The dominant, green-spored stromata are most likely *T. catoptron* (see Chaverri & Samuels 2003), which was described from Sri Lanka by Berkeley & Broome.

“N^o 1094 *Hypocrea multiformis* B & Br (No 5 partim), Peradeniya, Dec 1866” Fig. 9 C

This specimen is divided into several pieces, including two sheets with pieces of wood glued to them and two small packets. Each of two sheets bears the handwritten number 1094 and is stamped ‘Herb. Berk 1879’ and each has a handwritten determination, possibly by Berkeley. Some portions are labeled as *H. multiformis* and others are labeled as ‘*H. citrina* var.’ On one of the small packets, labeled as *H. multiformis*, the number 1094 written in pencil is barely visible. The second small packet is labeled by hand as “Ceylon 1094! *Hypocrea multiformis* Berk & Br! The yellow form.” The pieces labeled as ‘*Hypocrea citrina* var’ appear to be the same and different from all the others.

The following notes are taken from a piece that was glued to a piece of paper:

Stromata discrete, circular in outline, 0.5–1.3 mm diam, centrally attached, orange-yellow, KOH–, surface plane to slightly convoluted, perithecial elevations not evident, perithecial openings appearing as viscid dots against the lighter background, margin slightly scalloped. In section stroma surface region ca. 25 μm wide, comprising 2–3 layers of circular cells 10–12 μm diam, walls < 0.5 μm thick, pigmented (yellow in lactic acid). Tissue below surface region comprising loosely intertwined, much branched hyphae 3–5 μm wide, thin-walled. Cells below the perithecia conspicuously angular, 10–15 μm diam, thin-walled. Perithecial opening erumpent through stroma surface, formed by thin-walled, narrowly clavate cells. Asci (n = 30) cylindrical, (40–)50–62(–67) $\times$ (3.2–)3.5–4.0(–6.0) μm , apex thickened and with a pore, ascospores uniseriate. Part-ascospores (n = 30) hyaline, smooth slowly becoming spinulose, dimorphic. Distal part-ascospores globose to subglobose, 2.5–3.0(–3.2) $\times$ (2.2–)2.5–2.7(–3.0) μm . Proximal part-ascospores oblong to wedge-shaped, (2.5–)2.7–3.2(–3.5) $\times$ (1.7–)2.0–2.5 μm .

‘No 1096 *Hypocrea multiformis* No 33 partim Peradeniya [Dec] 1869’ (K, herb. Berkeley) Fig. 9 F, G

This specimen consists of two pieces of stiff paper, each with four pieces of bark glued to it. One piece bears the collecting information given above; the second simply is marked by hand as ‘*Hypocrea multiformis* [in ink] 1096 [in pencil].

There are no obvious differences in macroscopic characters between the stromata on the two parts of the collection. Stromata are scattered, discrete, slightly pulvinate–convex, centrally attached with margins free, surface plane, not wrinkled or tuberculate; perithecial elevations not evident, yellow with darker amber or brown ostiolar openings; stroma surface markedly orange in 3% KOH, yellow in lactic acid. Cells of the stroma surface angular, 7–12 μm diam, walls 1.0–1.5 μm wide. The specimen is immature; one stroma had a few developing ascospores, these were hyaline, dimorphic, the distal part-ascospores globose, proximal part-ascospores wedge-shaped.

‘33. *Hypocrea multiformis*, B et B Ceylon GHKT Nov 1867’ (K, Herb. Berkeley). Fig. 9 D, E

This specimen consists of several pieces of wood glued to a piece of paper. Stromata forming on bark and on decorticated wood; circular in outline, ($n = 17$) 0.7–1.7(–2.7) mm diam, superficial, scattered to gregarious, slightly convex, centrally attached, orange, surface plane, perithecial elevations not evident, perithecial openings appearing as viscid dots against the orange background; stroma surface and perithecial walls slowly red-orange in 3% KOH. Cells of the stroma surface in face view pseudoparenchymatous/angular, ca. 7 μm diam, thin-walled. Stroma surface region in section ca. 25 μm wide, cells angular, 4–7 diam, thin-walled, walls orange–red in 3% KOH, yellow in lactic acid. Region below the stroma surface comprising vertically oriented hyphae ca. 5 μm wide, infrequently branched, thin-walled. Cells below the perithecia pseudoparenchymatous, 10–15 μm diam, thin-walled. Perithecia ($n = 26$) closely-spaced, elliptic in section, 155–200 μm tall, 85–143 μm wide; ostiolar canal 40–65 μm long. Perithecial apex not sharply differentiated from the surrounding stroma tissue, clavate elements not seen. Asci ($n = 30$) cylindrical, (35–)44–50(–59) $\times$ (3.0–)3.7–4.5(–5.0) μm , apex thickened and with a ring, ascospores uniseriate. Ascospores ($n = 30$) hyaline, warted, monomorphic or nearly so, globose to subglobose. Distal part-ascospores (2.0–)2.2–3.0(–3.2) $\times$ (1.7–)2.0–2.7 μm . Proximal part-ascospores (1.7–)2.0–3.0(–4.0) $\times$ (1.7–)2.0–2.7(–3.0) μm .

Commentary: Type material of *H. multiformis* in Berkeley's herbarium includes four syntypes and possibly four distinct species. Specimens 33 and the immature 1096 are probably the same white-spored species. They differ from 1094 and 1095 in their reaction to 3% KOH. Ascospores of 1094 are considerably smaller than in the white-spored element of 1095, thus these two parts represent different species and 1094 could be the common tropical species *T. deliquescens* (Sopp) Jaklitsch (= *H. lutea* Petch). The diversity no doubt is reflected in the name, '*multiformis*,' which leads me to conclude that Berkeley was as confused about the identity of this species as we are. The protologue gives no clues as to which, if any, of the parts is actually *H. multiformis*. The most expeditious approach to the identity of *H. multiformis* is to designate the only truly distinctive element found on any of the syntypes as the lectotype, which is most likely *T. catoptron*, however a green-ascospored species was only found on one part of one collection. It seems likely that a white-ascospored species was intended. Two of the white-spored parts are immature (33, 1096) and are outside of consideration. The protologue does not enable me to distinguish between 1094 and 1095. If 1094 is *T. deliquescens* then selecting it as lectotype would place it in conflict with the younger name. Thus the most expeditious approach is to select part of specimen 1095 that is noted above as 'part 1', as lectotype of *H. multiformis*.

Hypocrea cesatiana Cooke 1883 was proposed to replace *H. multiformis* Cesati 1874, an illegitimate name that was later described as *H. multiformis* Cesati ex Sacc. in 1886, a later homonym of *H. multiformis* Berk. & Broome 1873,

Hypocrea neilgherrensis Berk. & Cooke [as '*nilherrensis*'] in Cooke, Grevillea 12: 79. Dec 1883[1884] (basionym). Fig. 10 A–E

≡ *Stilbocrea neilgherrensis* (Berk. & Cooke) Samuels, **comb. nov.** IF 901696

Type: "59 Neilgherries, E.C.B" (K, herb Berkeley!). HOLOTYPE.

Observations: The type consists of two pieces of bark glued to a piece of paper. Stromata thin, effused, growing over perithecia of *Thelonectria* sp, tan with white margin, composed of loosely intertwined, 3–4 µm wide hyphae. Perithecia 200–250 µm tall, 120–170 µm wide, completely immersed, only ostiolar openings visible. Perithecial wall ca. 15 µm wide, comprising a single region of cells having ± elliptic lumina, 4.5–8 µm long, 1.5 µm wide, walls ca. 1.5 µm thick, ostiolar canal periphysate. Perithecial apex blunt, 200–300 µm diam, formed of 3–4 µm wide hyphal elements, protruding at most slightly

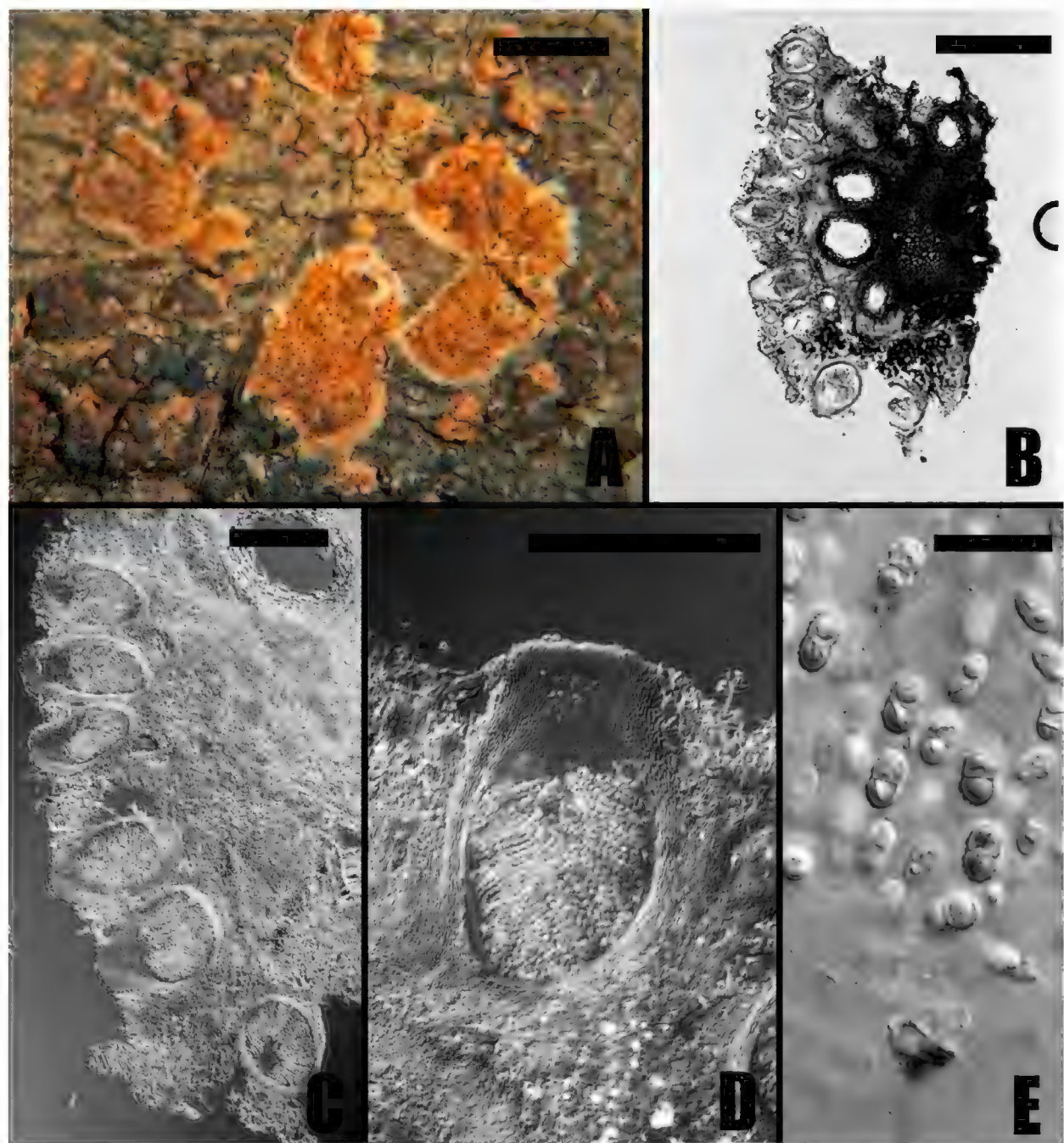


FIG 10. *Hypocrea neilgherrensis*. A. Stromata. B–D. Section through a stroma showing mature perithecia. E. Ascospores. Type. Scale bars: A = 2 mm, B = 500 μm , C = 150 μm , D = 75 μm , E = 10 μm .

above stroma surface. No reaction to 3% KOH. Asci cylindrical, $45\text{--}60 \times 6\text{--}9 \mu\text{m}$, apex simple, ascospores uniseriate but many becoming transversely uniseriate. Ascospores broadly ellipsoidal, $6.0\text{--}7.2 \times 3.5\text{--}4.2 \mu\text{m}$; hyaline, warted, warts scattered, $0.5\text{--}1 \mu\text{m}$ diam; bicellular, not disarticulating at the septum, septum median.

Commentary: *Hypocrea neilgherrensis* is obviously not a *Trichoderma*. The black synnemata and light colored, effused, hyphal stroma strongly suggest *Stilbocrea macrostoma* Berk. & M.A. Curtis However, ascospores of

S. macrostoma are larger ($9.5\text{--}12 \times 4.5\text{--}5.5 \mu\text{m}$) and spinulose, not markedly warted as they are in the present species. *Stilbocrea macrostoma* is often found growing on other pyrenomycetes (Samuels & al. 1990). Unfortunately, I could not observe details of the synnematus anamorph, but black synnemata are found in both *S. macrostoma* and *S. gracilipes* (L Tul. & C. Tul.) Samuels & Seifert (Seifert 1985). The nectria-like host was too badly decomposed for identification, but the perithecia suggested *Thelonectria jungneri* (Henn.) P. Chaverri & C. Salgado.

Hypocrea niphidium (Berk. & Broome) Cooke [as '*nephidium*', Grevillea 12: 105. 1884.

≡ *Hypoxylon niphidium* Berk. & Broome [as '*nephidium*', J. Linn. Soc. 14: 122. 1873[1875].

≡ *Melogramma niphidium* (Berk. & Broome) Sacc., Syll. Fung. 2: 146. 1883.

≡ ***Broomella niphidium*** (Berk. & Broome) Petch, Ann. Roy. Bot. Gard. Peradeniya 6: 345. 1917.

Type: The type specimen was not examined for the present work. According to Petch (1917), Berlese (1894, Icones Fungorum 1: 50) stated that the original material is sterile. Petch (1917) studied a 'cotype' from the herbarium of Peradeniya and provided the following description (repeated in Petch 1924) as follows:

"The co-type in Herb. Peradeniya bears mature stromata. They are superficial, circular, up to 4 mm diameter, pulvinate or flattened pulvinate, minutely tomentose, with prominent ostiola, and apparently pale yellow. The tissue of the stroma is rather loose and white. The perithecia are situated at varying depths and have thick yellow walls; the perithecial cavity is oval, about $0.35 \times 0.25 \text{ mm}$, and the neck is up to 1.5 mm long, totally immersed. The asci are 6–8 μm in diameter, with uniseriate spores. The spores are hyaline, fusoid, spinulose, three-septate, slightly constricted, ends apiculate or rounded, $30\text{--}34 \times 6\text{--}8 \mu$; sometimes one cell is inflated."

Petch (1917, 1924) concluded that *Hypoxylon niphidium* is a species of *Broomella* Sacc. (*Amphisphaeriaceae*), ascospores of which have a short apiculus, unlike *B. vitalbae* (Berk. & Broome) Sacc., where ascospores have a long terminal filament.

Hypocrea ochroleuca Berk. & Ravenel, in Berkeley, Grevillea 4: 14. Sep 1875. Fig. 11 A–G

≡ *Trichoderma ochroleucum* (Berk. & Ravenel) Jaklitsch & Voglmayr, Mycotaxon 126: 150. 2014.

Type: “*Hypocrea ochroleuca* Berk. & Ravenel 1382, on trunks of *Myrica cerifera*, S[outh] C[arolina], HWR near *S. luteovirens*” (K, Herb. Berkeley! LECTOTYPE *hic designatus* IF 901697. Isotype: NY!).

Observations: The portion in K consists of two pieces of wood with bark glued to a piece of stiff paper. Stromata are indefinitely effused, thin, <0.5 mm thick, with a ¼ – ½ mm wide sterile, white margin (lacking in older stromata), overgrowing an abundantly-formed black pyrenomycete and immature *Hymenochaete* ? *tenuis* (det. E. Parmasto); the central, fertile, portion brownish–orange, no reaction to KOH; perithecia completely immersed, the ostiolar openings visible as darker brown against the lighter background. Stroma in section with a poorly defined surface region ca. 25 µm wide, formed of ± compact, intertwined, 3.0–4.5 µm wide, smooth or warted hyphae with many free ends protruding at the stroma surface. Tissue below the stroma surface of loosely intertwined hyphae. Stroma tissue below perithecia of very loosely disposed hyphae with somewhat enlarged, 4–12 µm wide cells; a region of highly compact hyphae forms on the surface of the *Hymenochaete* host. Perithecia scattered, in section subglobose, 190–270 µm tall, 160–235 µm wide, ostiolar canal ca. 60 µm long; perithecial apex formed of narrow hyphal elements protruding through stroma surface. Asci cylindrical, (75–)80–97(–100) × (4.5–)5.5–6.5(–9.0) µm, ascospores 1-seriate, apex simple. Ascospores hyaline, spinulose; part-ascospores dimorphic. Distal part-ascospores subglobose, (4.0–)4.5–5.2(–5.7) × 3.5–5.5 µm; proximal part-ascospores wedge-shaped to ellipsoidal, (3.7–)4.2–5.2(–5.5) × (3.2–)3.5–4.5(–5.2) µm.

Commentary: The isotype of *H. ochroleuca* (NY) is no different from the portion in K. It consists of several fragments of bark with stromata; few asci were seen. Although the original description did not mention a fungal substratum for this species, the stromata clearly grow over a very young basidiome of *Hymenochaete* ? *tenuis* as well as an immersed, black pyrenomycete. Jaklitsch (2011) redescribed this species, which is temperate in distribution, rare in North America but more common in Europe. *Trichoderma albofulva* (Berk. & Broome) Samuels, described from Sri Lanka, is very similar but has somewhat larger ascospores and is apparently tropical in distribution. *Trichoderma ochroleuca* is a member of the Viride Clade of *Trichoderma*.

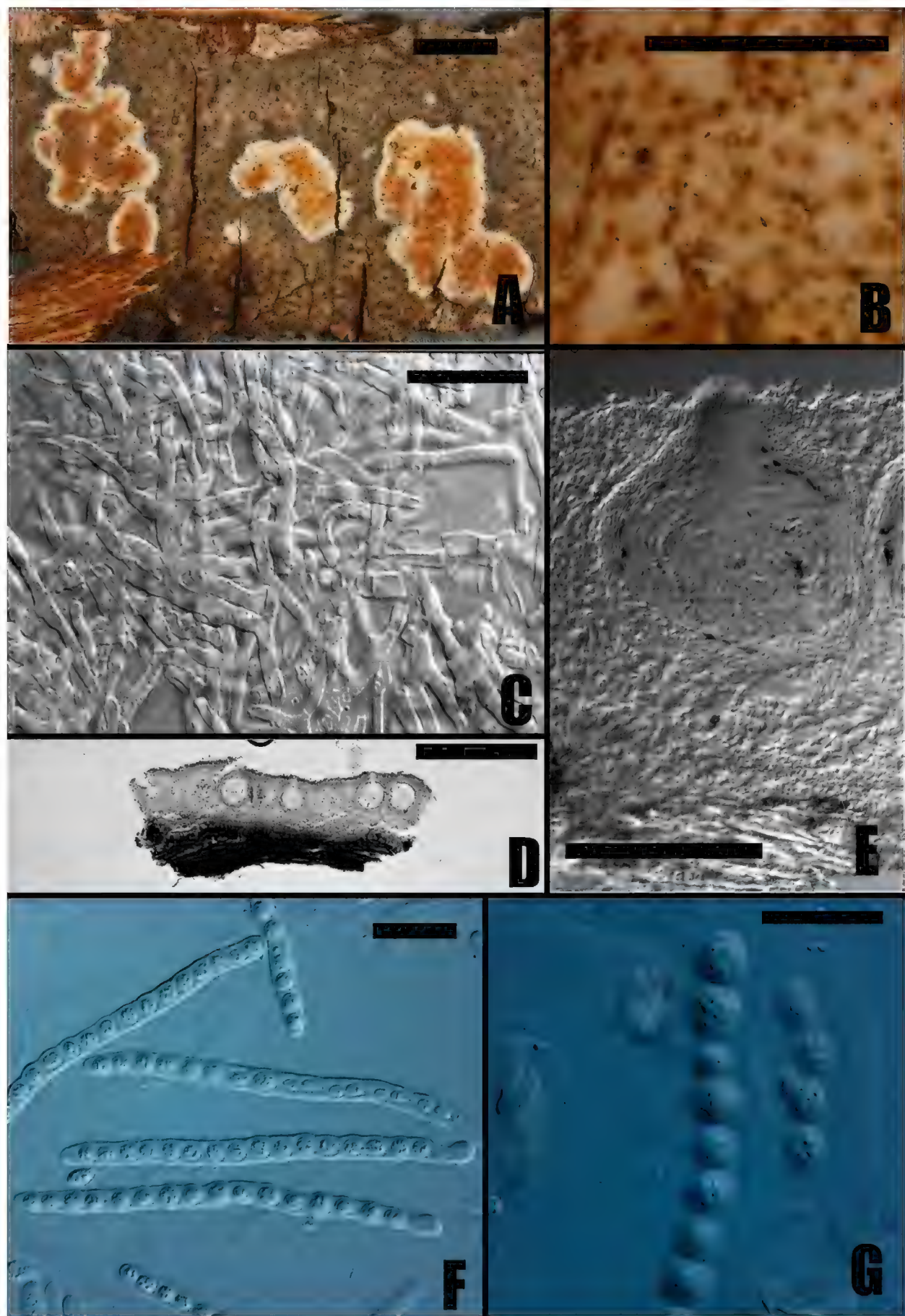


FIG 11. *Hypocrea ochroleuca*. A. Stromata. B. Surface of stroma showing dark perithecial openings. C. Hyphae of the stroma. D. Section through a stroma. E. Section through a mature perithecium. F, G. Asci and ascospores. A, B, F, G from NY; C–E from K. Scale bars: A = 5 mm, B, D = 1 mm, C, G = 10 μ m; E = 50 μ m, F = 20 μ m.

Hypocrea palmae Berk. & M.A. Curtis, J Acad Nat Sci Philadelphia ii, 2: 285. 1853. Fig. 12 A–D

≡ *Moelleriella palmae* (Berk. & M.A. Curtis) P. Chaverri & K.T. Hodge, Stud Mycol 60: 46. 2008.

Type. Surinam, Herb Schweinitz (K(m)52653!).

Observations: The holotype specimen consists of a piece of stiff paper to which are fixed two black, subglobose stromata, the largest of which measures 8 mm × 3 mm. There is also a small packet with a part of a palm leaf. Black stromata are partially immersed in the palm leaf. Perithecia are completely immersed in the stroma. In 3% KOH stromata are pale orange with darker ostiolar areas. Asci are narrowly clavate; the apex is thickened with a ring. Ascospores are filiform, septate, disarticulating into cylindrical part-spores, 6.2–8.5 × 2.0–2.7 µm.

Commentary: A scale insect was not detected on the type specimen. The species is redescribed and illustrated by Chaverri & Hodge (2008), who listed several synonyms and reported the species from Brazil, Peru and Surinam. According to Chaverri & Hodge the anamorph of this species is not known; the anamorph reported for this species by Petch (1921) is based on a collection from Trinidad and is most likely not this species but rather *Moellerella globosa* P. Chaverri & K.T. Hodge.

Hypocrea palmicola Berk. & Broome, J Linn Soc Bot 14: 112. 1875 [3 Dec. 1873]. Fig. 12 E–G

≡ *Creopus palmicola* (Berk. & Broome) Boedijn, Sydowia 5: 211. 1951.

= ? *Trichoderma*

Type: Ceylon 42. “0.00025” diam, pale brown” (K, Herb. Broome “in type cover”!). HOLOTYPE

Observations: The holotype specimen consists of several fragments of what appears to be decorticated wood adhering to a piece of paper. Several stromata are present. Stromata minute, 1–2 mm diam × 1–1.5 mm high, centrally attached, brown to brownish gray, not reacting to 3% KOH, surface plane and flat or convex, perithecial elevations not visible. Ostiolar openings appearing as minute black dots against a dark brown background. Cells of the stroma in face view distinctly angular, 7–16 µm diam, walls 1–1.5 µm thick. Asci cylindrical, 90–110 × 5–6 µm, apex thickened, with a ring. Part-ascospores green, spinulose, dimorphic rarely monomorphic and subglobose to oblong, distal part subglobose to conical, 4.5–5.5–(6.0) × (3.5–)3.7–4.2 µm; proximal part wedge-shaped, (4.2–)4.5–6.0(–6.5) × 3.5–4.2 µm.

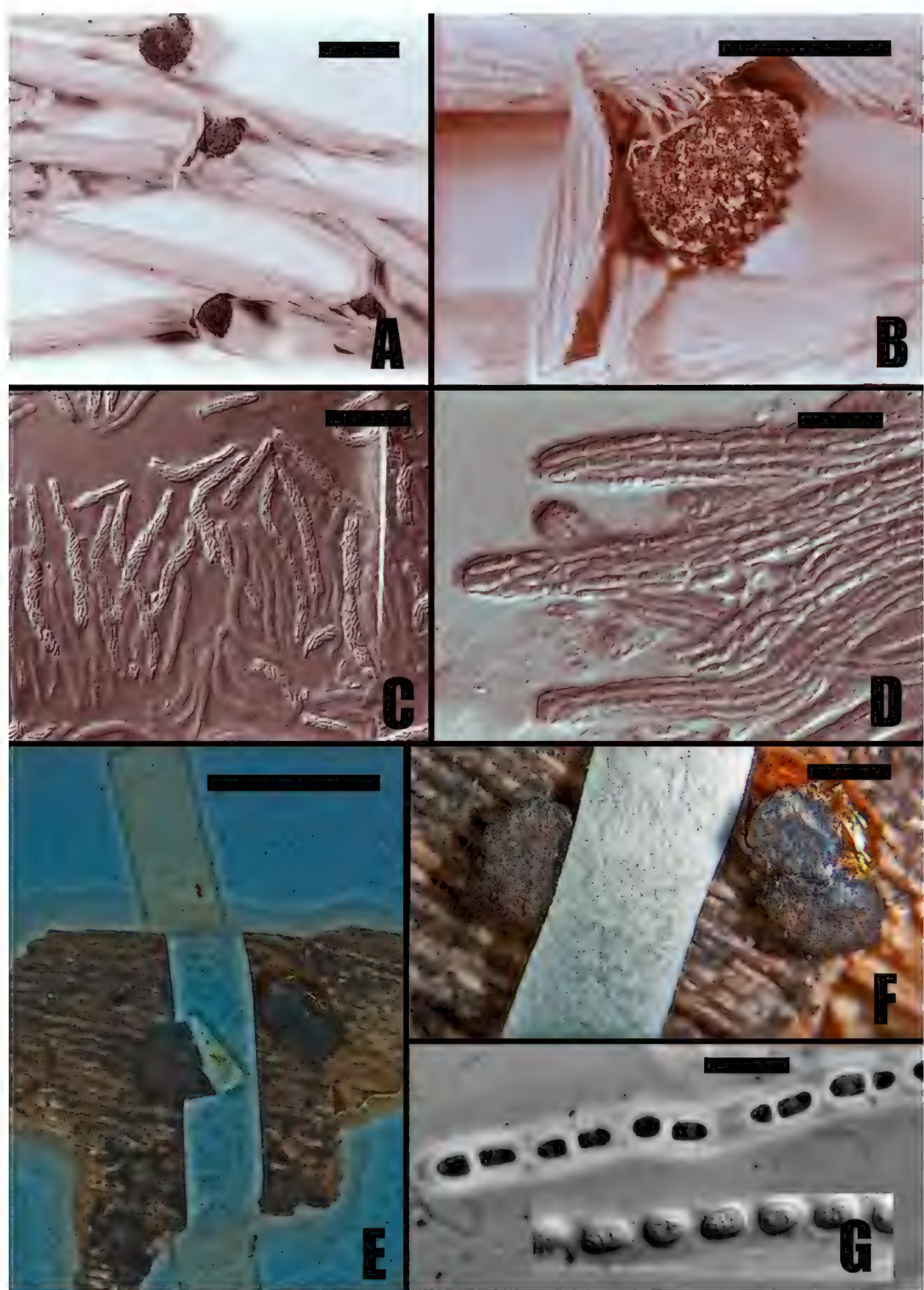


FIG 12. A–D. *Hypocrea palmae*. A, B. Stromata. C, D. Asci and ascospores. Type. E–G. *H. palmicola*. E, F. Stromata. G. Asci and ascospores. Type. Scale bars: A, B, C = 20 μm ; D = 10 μm , E = 5 mm, F = 1 mm, G = 10 μm .

Commentary: The original description (Berkeley & Broome 1875) lists the substratum for ‘No. 42’ as a leaf of a palm. The substratum in the type collection appears to be decorticated wood and not palm. There is a second packet on the type sheet (K). Stromata in this collection are minute, brown, discrete, discoidal and the surface is wrinkled. This portion is immature.

Chaverri & Samuels (2003) listed *H. palmicola* as an ‘excluded or doubtful’ species of green-spored *Hypocrea* (= *Trichoderma*), comparing the species to *H. rugulosa* Berk. & Cooke., which was described from India.

Hypocrea parasitans Berk. & M.A. Curtis, in Berkeley, Grevillea 4: 15. Sep 1875.

Type: “6190. *Hypocrea parasitans* B. & C. in *Hydnum erinaceum*” (K, herb. Berk 1879!).

Observations: The holotype consists of what are probably excised teeth of a *Hydnum* basidioma having buff-colored amorphous material on them. There is no sign of an identifiable fungus.

Commentary: This species was based on material collected in South Carolina. Ellis & Everhart (1892) and Seaver (1910) concluded that this species was represented by ‘imperfect material.’ It is excluded from *Trichoderma*.

Hypocrea peltata (Jungh.) Berk., Hooker’s J. Bot. Kew Gard.3: 205. 1851, nom. nov.

≡ *Sphaeria peltata* Jungh., Praem. in Flor. Crypt. Javae. Fasc : 20.1838, nom. illeg., non DC. 1805.

≡ ***Trichoderma peltatum*** (Jungh.) Samuels & al., in Jaklitsch & Voglmayr, Mycotaxon 126: 151. 2014.

Type: INDONESIA. JAVA: *Junghuhn 103* (L 00532089, Hb. Ludg. Bat. 910.250.1421!).

Observations: The type specimen was illustrated by Samuels & Ismaiel (2011). The type specimen consists of several fragments of rotten wood and three *Trichoderma* stromata. These are peltate, circular in outline, centrally attached by a very short stipe with margins free, 10–27 × 10–22 mm diam, tan, surface verrucose, not reacting to 3% KOH. Perithecia abundant, completely immersed and perithecial elevations not evident. Ostiolar openings nearly concolorous with the surface. The underside is lighter, cream, with more or less conspicuous shallow gill-like furrows that radiate to the margin from the stipe giving the appearance of a parasitized agaric; these ridges are formed of broad, thick-walled, short-celled hyphae. Clamps or basidia not seen.

Perithecia crowded, elliptic in section, 337 ± 29 (306–385) μm tall, 210 ± 22 (165–245) μm wide. Ostiolar canal 60–122 μm long. Cells around the ostiolar opening narrow, slightly clavate, terminating to form a palisade even with the surface of the stroma. Stroma surface ca. 30 μm wide, composed of intertwined hyphae that, in section, appear to be elliptical cells $5\text{--}8 \times 2.5\text{--}2.5$ μm , thin-walled, non pigmented. The tissue immediately below the surface loosely intertwined, 2.5–5 μm wide, smooth, septate hyphae with a lot of space in between hyphae. Tissue below perithecia compact, intertwined hyphae 2.5–5. μm wide, thin-walled. Asci narrowly clavate, sessile, no apical discharge mechanism seen. Part ascospores hyaline, finely spinulose, monomorphic and subglobose to slightly dimorphic and proximal part wedge-shaped. Each ascus has 4 large spores and 4 small spores. Distal part-spores (30): 3.1 ± 0.5 (2.3–4.1) $\times$ 2.9 ± 0.3 (2.3–3.4) μm ; proximal part-spores (30): 3.3 ± 0.5 (2.3–4.5) $\times$ 2.8 ± 0.2 (2.3–3.2) μm .

Commentary: *Trichoderma peltatum* is unusual in the genus because its anamorph does not present a typical trichoderma-like morphology; rather the anamorph comprises thick-walled, stalked chlamydospore-like structures (Samuels & Ismaiel 2011). Stromata of *T. peltatum* are among the largest and most conspicuous found in the genus. Samuels & Ismaiel (2011) redescribed this pansubtropical species and listed several synonyms. Jaklitsch & Voglmayr (2015) included this species in the Longibrachiatum Clade of *Trichoderma*.

Hypocrea petersii Berk. & M.A. Curtis, in Berkeley, Grevillea 4: 13. 1875. (basionym). Fig. 13

≡ *Podocrea petersii* (Berk. & M.A. Curtis) Sacc & D. Sacc., Syll. Fung. 17: 799. 1905.

≡ *Trichoderma petersii* (Berk. & M.A. Curtis) Samuels, **comb. nov.** IF 901698

Type: USA: *Alabama*: [substratum unknown]. *Peters 5251* (K(m) 52654!).

Observations: The holotype specimen consists of one 7 mm thick section of an apparently large stroma. It was not possible to discern from the specimen how the stroma was attached to the substratum but it appears to have a large, expanded cap and a short thick stipe (see Doi 1975b, 1979). The stroma is light brown; the surface is densely villose and minutely tuberculate from perithecial elevations. Hyphae at the stroma surface are very fine and possibly represent a contaminant. The texture of the stroma is corky. There is no reaction of the stroma to KOH but perithecial walls become reddish. The stroma surface region is ca 50 µm wide and comprises two layers. Cells of the surface have thickened walls and yellowish accretions. The tissue immediately below the surface comprises short, 3 µm wide, intertwined hyphae; this tissue intergrades with the tissue between perithecia, which comprises longer, loosely disposed, ca 4 µm wide hyphae. The papilla extends through the stroma surface and is composed of small, flattened cells in files. The stroma tissue below perithecia is formed of compact, intertwined hyphae with some cells conspicuously enlarged and thick-walled. Perithecia are elliptic in section, (445–)500–600(–700) µm tall, (180–)225–325(–400) µm wide; the ostiolar canal is 120–170 µm long and filled with periphyses. Asci are not well-preserved and cannot be measured or described. Part-ascospores are hyaline, finely spinulose, dimorphic or monomorphic and subglobose. Distal part-ascospores, subglobose to subellipsoidal, (4.0–)5.0–6.0(–6.2) × (4.0–)4.2–5.2 µm; proximal part-ascospores ellipsoidal, wedge-shaped to subglobose, (4.5–)5.0–6.2(–7.0) × (3.5–)4.0–4.7(–5.0) µm.

Commentary: The large, substipitate stroma of *H. petersii* lead to its placement in *Podocrea* (Sacc.) Lindau (Saccardo & Saccardo 1905). Seaver (1910) considered *H. petersii* as a synonym of *Hypocrea brevipes* Mont., but *H. brevipes* is a tropical species having much smaller stromata (Samuels & Lodge 1996).

Doi (1975b, 1979) redescribed *H. petersii* twice based on his study of the type collection and a Roland Thaxter collection from Tennessee (FH). We have not seen the Thaxter collection. Doi compared *H. petersii* to other species

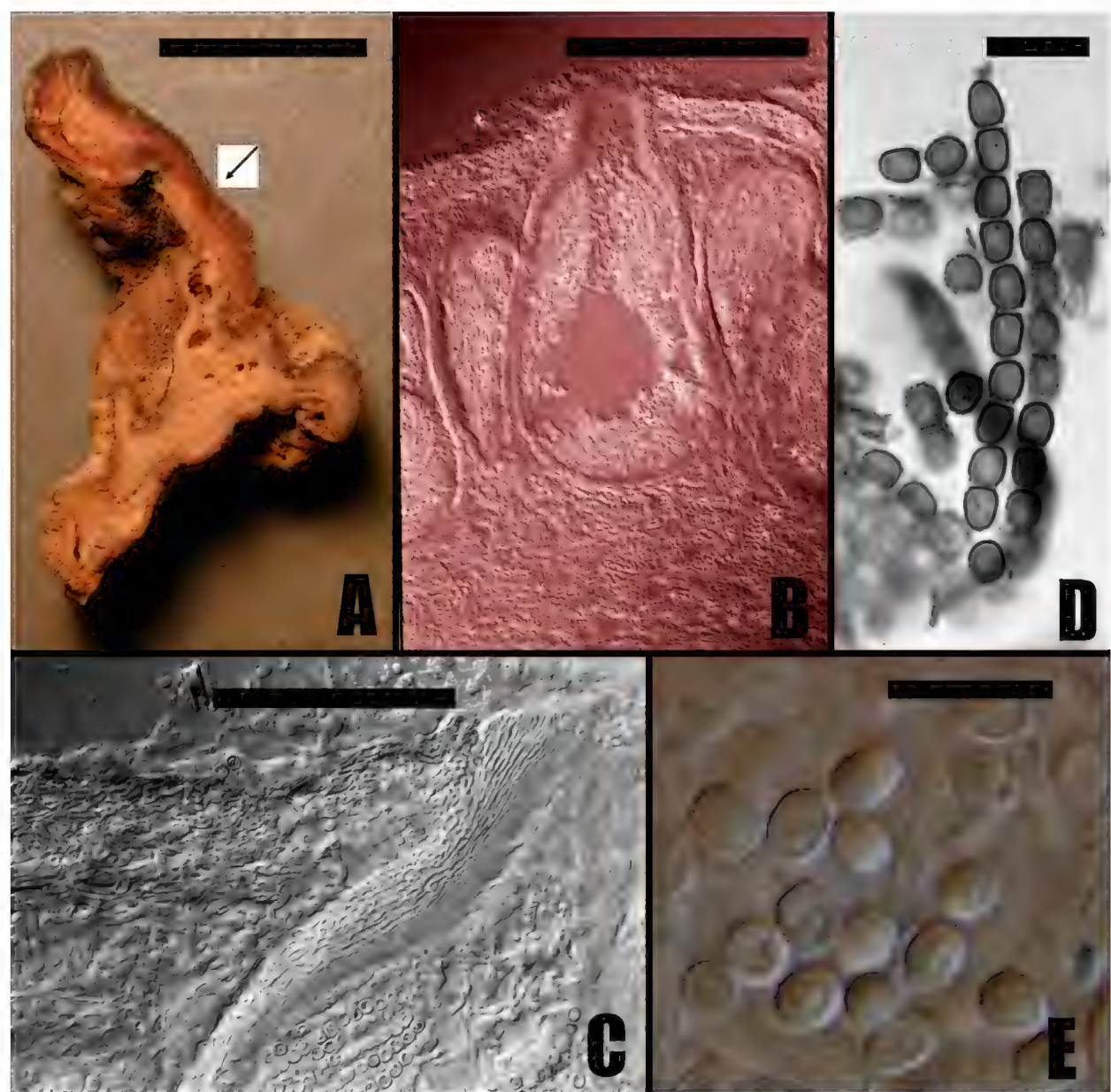


FIG 13. *Hypocrea petersii*. A. A section of a stroma, the perithecial layer indicated by the arrow. B. Section through a stroma showing a mature perithecium. C. Section through a mature perithecium showing the perithecial apex and the stroma surface. E. Discharged part ascospores. Type. Scale bars: A = 10 μ m, B, C = 250 μ m; D, E = 10 μ m.

having large stromata, including *H. peltata* (= *T. peltatum*), which is found also in the southern states of the USA. He considered that the stroma of *H. petersii* differs from that of *T. peltatum* in being ‘larger and thicker’ and in the protruding perithecial papilla. The stromata of both species are hyphal; there is no pseudoparenchymatous tissue. The most conspicuous difference between *T. petersii* and *T. peltatum* is that the ascospores in the former are all the same size whereas in the latter, half the bicellular ascospores are bigger than the other half of the bicellular spores.

Hypocrea pezizoides Berk. & Broome, J Linn Soc Bot 14: 112. 1875. Fig. 14

≡ *Trichoderma pezizoides* (Berk. & Broome) Samuels & al., Mycotaxon 126: 152. 2014.

= *Trichoderma pezizoideum* Wallr., Fl. Germ. 2: 246. Feb–Mar 1833, *nom. rej. prop.* (Samuels 2014).

Type: SRI LANKA “*Hypocrea pezizoides* No. 308, Cent Province, Dec 1868, sent before but these specimens in better fruit” (K, Herb. Berk 1879!). LECTOTYPE (Bissett et al. 2015).

Isotypes: “*Hypocrea pezizoides*, B. & Br., 308, Cent. Prov. (K, Hb. Berk 1879).” *Hypocrea pezizoides*, substrate undetermined, coll. Thwaites 308 (C.G. Lloyd mycological collection, Smithsonian Institution No. 6055; BPI 715639!).

Representative culture: CBS 101131.

Representative sequences: *tefl* AY225859, *rpb2* JN715610, AF545564.

Observations: The lectotype consists of several stromata glued to a piece of paper. No anamorph is visible. The stromata have formed on bark; they are orange, centrally attached with margins free, and measure 5–15 mm diam, 1–2 mm high. The stroma surface is plane, at most slightly wrinkled with perithecial openings appearing as minute dark dots. In 3% KOH the stroma surface becomes dark red, nearly black. The underside of the stroma is furfuraceous and lighter in color. Cells of the stroma surface in face view small and angular. In section the stroma surface is a crust ca. 90 µm thick; the outer 20–25 µm of the crust comprise angular cells ca 5 µm diam with walls ca 1 µm thick. Perithecia are elliptical to subglobose in section, 240–285 µm high, 120–225 µm wide, ostiolar canal 75–90 µm long; the cells lining the ostiolar canal are narrow hyphal elements that protrude slightly through the stromal surface, clavate elements are lacking. The tissue between perithecia comprises loosely disposed, intertwined hyphae. Immediately below the perithecia is a region of densely disposed, ca. 5 µm wide, hyphae with walls ca. 1.5 µm thick; this intergrades into a mixture of broad, ca. 10 µm wide hyphae with walls 1.5–2 µm thick and circular cells ca 15 µm diam with walls ca 1 µm thick. The lower surface of the stroma comprises hyphae with walls 1–2 µm thick that have many free ends and that appear to slough off to give the furfuraceous aspect. Asci are cylindrical, 95–110 × 4.2–7.0 µm, and contain 16 part-ascospores, the apex has a pore. Ascospores are bicellular and disarticulate in the ascus to form 16 more or less broadly ellipsoidal to subglobose part-ascospores, are hyaline, finely spinulose, more or less monomorphic, 4.0–6.5 × 4.7–6.0 µm.

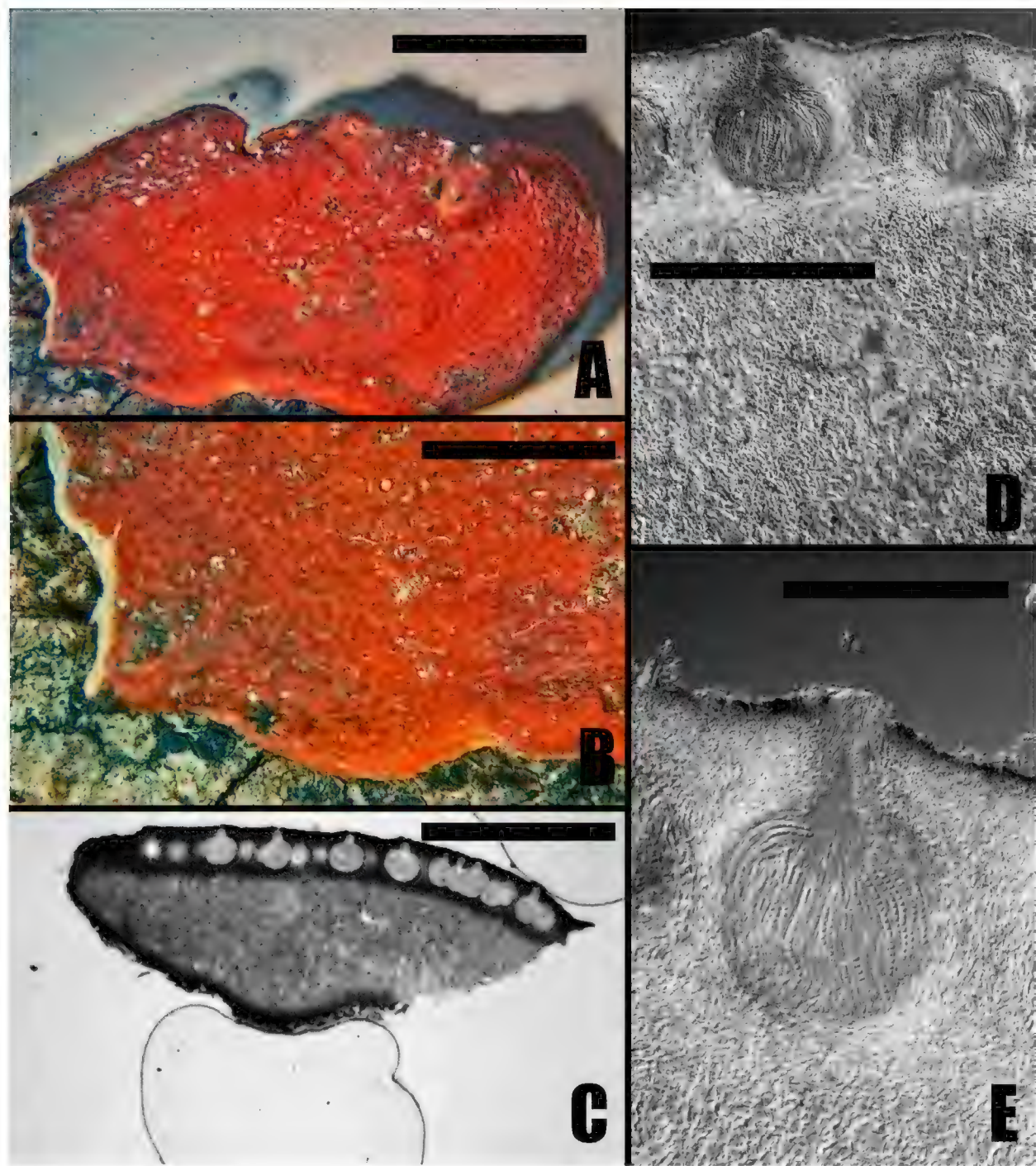


FIG 14. *Hypocrea pezizoides*. A, B. Stroma. Detail of surface shown in B. C. Section through a stroma showing arrangement of perithecia. D, E. Section of a stroma showing mature perithecia. All from '308, *sent before*, K. Scale bars: A = 10 mm, B = 5 mm, C = 1 mm, D = 500 μ m, E = 100 μ m.

Commentary: Samuels (2014) proposed conservation of *H. pezizoides* over the older *T. pezizoideum* Wallr. The sequences deposited in GenBank are diverse, most likely representing more than one species. The representative culture cited here was unequivocally derived from ascospores.

Trichoderma pezizoides is common in Thailand (several specimens are deposited in BPI) and has a widely reported distribution in Asia (China,

Japan), the Philippine Islands, and Papua New Guinea in the western Pacific region (Teng 1939, Lloyd 1924, Carroll 1963, 1964; Doi 1971, 1972, Tamura & al. 2000). Doi (1971) and Liu & Doi (1995) redescribed the species, including a verticillium-like *Trichoderma* anamorph. Liu & Doi (1995) deposited two Chinese collections from which they derived cultures as HKAS 28719 and 28727. Tamura & al. (2000) sequenced the ITS region of rDNA but apparently those sequences were not deposited in GenBank. Jaklitsch & al. (2006) placed *T. pezizoides* within *Trichoderma* sect. *Trichoderma* (the *T. viride* clade). *Trichoderma pezizoides* is one of the most conspicuous and characteristic species in the genus because of its large, discoidal, red or red-orange stromata. However, there is some evidence to suggest that this phenotype comprises more than one species. First, Tamura & al. (2000), who sequenced a 500 bp long region of ITS + 5.8S rDNA, found a single bp difference and one deletion in respective Chinese and Japanese strains. Second, Liu & Doi (1995) observed differences in conidial color between a Chinese and a Japanese strain. Third, there are significant differences in dimensions of part-ascospores when the type collection is compared to collections from Thailand (3) and the Philippine Islands (1):

Type (Sri Lanka): Distal part: $4.0\text{--}6.5 \times 4.7\text{--}6.0 \mu\text{m}$. Proximal part: $5.5\text{--}7.0 \times 4.2\text{--}5.5 \mu\text{m}$

Thailand: Distal part: $8.0\text{--}9.2 \times (6.2\text{--})7.2\text{--}8.5\text{--}.2) \mu\text{m}$. Proximal part: $(7.2\text{--})8.2\text{--}10.2\text{--}(11.0) \times (4.7\text{--})6.2\text{--}7.5\text{--}(8.0) \mu\text{m}$

Philippine Islands: Distal part: $3.0\text{--}5.2 \times 2.5\text{--}3.0 \mu\text{m}$. Proximal part: $2.0\text{--}6.5 \times 1.5\text{--}2.7 \mu\text{m}$.

Hypocrea polyporoidea Berk. & M.A. Curtis, in Berkeley, Grevillea 4: 15. Sep 1875. Fig. 15

Type: “*H. polyporoides* B, on *Fagus*, 6110 Alabama, leg. Peters” [K(m) 58321, Herb MC Cooke 1885!]. HOLOTYPE

Observations: The holotype collection consists of a small piece of quite rotten wood measuring ca 15 mm long $\times$ 7 mm wide. A thin, whitish, granular mycelium grows over the substratum. Perithecia are superficial on the mycelium, densely gregarious in great numbers and forming a crust, groups of perithecia are separated by narrow bands of white mycelium. Perithecia are orange, not changing color in 3% KOH, subglobose to broadly pyriform, in section ca 170 μm in diameter. There is a small crown of white mycelium around the ostiolar opening, leaving the opening itself free; hyphae of the crown are branched, cylindrical to vesiculose (closer to the perithecia) and smooth. Perithecia are completely free; the perithecial wall is narrow, ca 15 μm

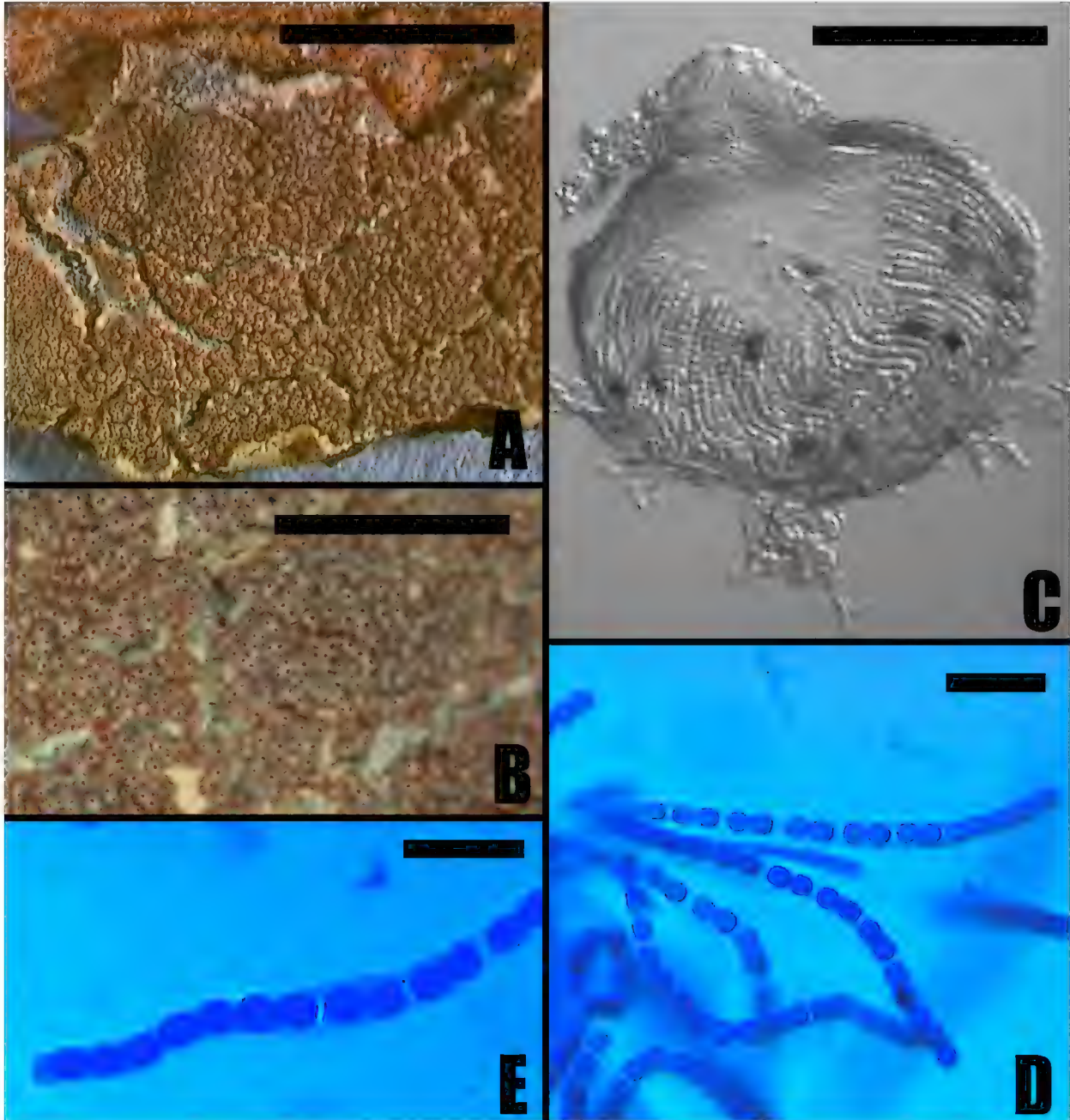


FIG 15. *Hypocrea polyporioidea*. A, B. Stroma. Detail of the semi immersed perithecia seen in B. C. A perithecium in median longitudinal section. D, E. Asci and ascospores. Type. Scale bars: A = 10 mm, B = 5 mm, C = 100 µm; D, E = 10 µm.

wide and composed of several layers of small, indistinct cells. The perithecial apex is distinctly papillate; the papilla is ca 50 µm high, formed of chains of small, thin-walled cells which, at the exterior, merge with the hyphae of the perithecial crown. Asci are cylindrical, $60\text{--}70 \times 3.5\text{--}5.5$ µm and have an obscure ring in the apex. Ascospores are bicellular, disarticulating into part-ascospores while in the ascus; part-ascospores monomorphic, subglobose to ellipsoidal, distal part $(2.2\text{--})2.7\text{--}3.2(\text{--}3.5) \times (1.7\text{--})2.2\text{--}3.0(\text{--}3.2)$ µm, proximal part $(2.2\text{--})2.5\text{--}3.2(\text{--}3.7) \times (2.0\text{--})2.2\text{--}2.7(\text{--}3.0)$ µm, hyaline, finely spinulose. No anamorph is present on the specimen.

Commentary: It is possible that the white mycelium of *H. polyporoidea* is actually growing on a crustose basidiomycete. As was noted by Berkeley himself in the protologue, this is ‘a very curious species.’ It is known only from the original gathering. Lloyd (1924) illustrated the type specimen and commented that the species was badly named because “its suggestion of a *Polyporus* is not obvious.” In this species perithecia are independent of each other, suggesting that it is not a species of *Trichoderma*.

Hypocrea ravenelii Berk., Grevillea 4: 14. 1875. Fig. 16

≡ *Broomella ravenelii* (Berk.) Sacc., Syll. fung. 2: 558. 1883.

= *Melogramma campylosporum* Fr., Summa Veg. Scand. p 386. 1849. (fide Laflamme 1975).

Type: “*Hypocrea ravenelii*, B., *Ostrya virginica*, Santee Canal, SC [South Carolina]. H.W.R.” (K, Herb Berk.!). LECTOTYPE hic designatus. IF 901699

Isotype: Exsiccata: Ravenel, Car Inf. No 1875. (BPI 631648).

Observations: The lectotype specimen consists of two pieces of bark glued to a piece of stiff paper. There are abundant, black to reddish tuberculate stromata 1.0–1.5 mm diam × 1 mm high. Perithecia are cespitose in groups of up to 30, globose, non papillate, cupulate when collapsed, black but with reddish granules on the surface. Asci are clavate, ca 120 × 10–15 µm, sessile, thin-walled, 8-spored, apex slightly thickened. Ascospores arcuate, tapered uniformly to each subacute end, 38–42 × 4.5–5.5 µm, 3-septate, olivaceous (in 3% KOH), smooth, bi- to multiseriate in the ascus. More or less filamentous, sterile material is present among the asci but whether this material represents paraphyses or is the remains of discharged asci could not be determined. Cooke (1884) synonymized *H. scutellaeformis* Berk. & M.A. Curt and *H. ravenellii* Berk.

Commentary: The red, granular material on the stromatic perithecia apparently lead Berkeley to place this species in *Hypocrea*, where it clearly does not belong. Laflamme (1975) included *H. ravenelii* in synonymy of *Melogramma campylosporum*, which he redescribed and to which he attributed an anamorph, *Cytosporina bulliardii* Höhn. In the protologue Berkeley included *Ostrya virginiana* (as *O. virginica*) and *Acer rubrum* as hosts; Laflamme restricted the species to *Carpinus* and *Ostrya*.

Cooke (1884) said that *H. ravenelii* ‘B. in Raven. Fungi Car.’ and *H. scutellaeformis* ‘B & C’ are two names for the same species. I am not aware of any specimens of *H. scutellaeformis* ‘B & C;’ *H. scutelliformis* Berk. & Ravenel [as ‘*scutellaeformis*’] was issued as a new species in Ravenel, Fungi Caroliniani iv, 31 and is a good species of *Trichoderma* and clearly not the same as *H. ravenelii*.

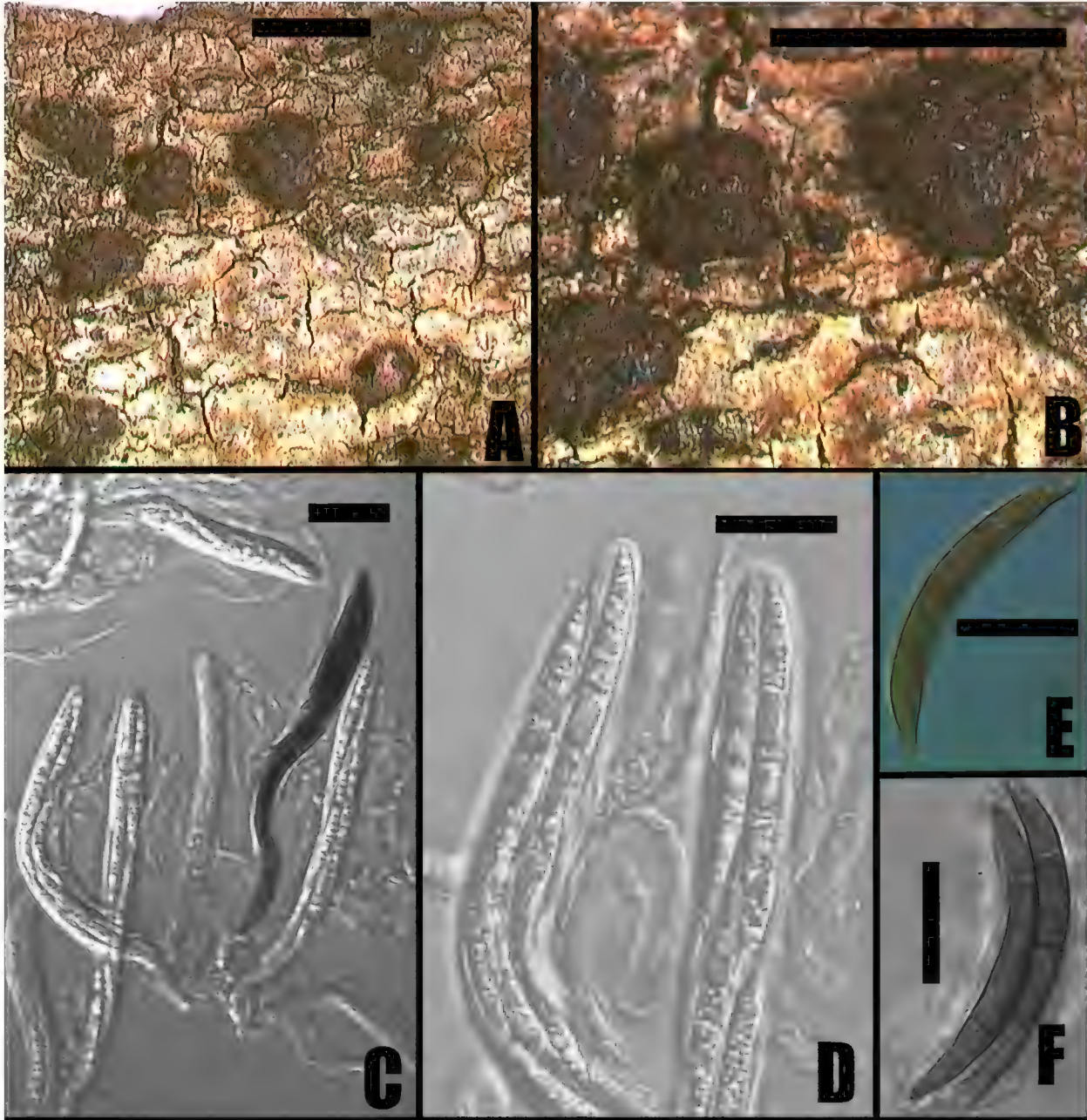


FIG 16. *Hypocrea ravenelii*. A, B. Stromata. C, D. Asci. E, F. Ascospores. Type (K). Scale bars: A, B = 2 mm, C = 30 µm, D–F = 10 µm.

Hypocrea riccioidea (Bolton) Berk., Outl. Brit. Fung. (London): 383 (1860).

≡ *Sphaeria riccioidea* Bolton, Fungi Halifax 4: 182. 1791.

≡ *Dozya riccioidea* (Bolton) P. Karst., Symb. Mycol. Fenn. 2: 221. 1873, gen. illeg., Art. 53.

≡ *Hypocreopsis riccioidea* (Bolton) P. Karst., Symb. Mycol. Fenn. 2: 251. 1873.

= ***Hypocreopsis lichenoides*** (Tode) Seaver, Mycologia 2: 82. 1910. (fide Seaver, 1910; Rossman & al., 1999).

Commentary: According to Dennis (1975) the type collection of *S. riccioidea* at K is in poor condition and was not examined for this study.

Hypocrea richardsonii Berk. & Mont. [as ‘*richardsoni*’], *Grevillea* 4: 14 (1875) nom illeg, (Art. 53.1) non Vesterg. 1867 [= *Peniophora rufa* (Fr.) Boidin 1959].

Commentary: The identity of *H. richardsonii* Berk. & Mont. Is unknown and irrelevant because it is a later homonym. The type specimen was not examined for this study. In its protologue *H. richardsonii* was described as follows: On Poplar. New England, Maine, New York. “Bright, rufous–red, orbicular, scattered, plane, or crowded and corrugated; asci clavate; sporidia elliptic. First gathered in one of the Arctic Expeditions by Sir J. Richardson.” Several collections have been deposited in BPI under this name.

Hypocrea richardsonii is excluded from *Trichoderma*.

Hypocrea rugulosa Berk. & Cooke in Cooke, *Grevillea* 12: 79. 1883 (basionym). Fig. 17 A–D

≡ ***Trichoderma rugulosum*** (Berk. & Cooke) Samuels, comb. nov. IF 901700

= ? *Hypocrea rugulosa* Berk. & Cooke var. *major* Berk. & MC Cooke in Cooke, *Grevillea* 12: 79. 1883.

Type: “*Hypocrea rugulosa* B et Cooke in *Grevillea* Neilgherries [India] ECB” (K, Herb Berk.!). HOLOTYPE.

Description: The type collection consists of several pieces of decorticated wood glued to a piece of paper. Stromata are formed on a resupinate basidiomycete, on an effused black fungus and on decorticated wood, they are gregarious, discoidal, 1. 0–1.5 mm diam, 1 mm high, brown, surface deeply furrowed or wrinkled, surface orange in 3% KOH. Cells of the stroma surface in surface view lack a definite outline, 5–10 µm diam, with walls 1.5 µm thick. The stroma lacks a morphologically differentiated surface region; cells of the outermost ca 25 µm of the stroma are pigmented, angular, 5–12 µm diam, with walls ca 2.5 µm thick; these cells are built up to give the stroma a rugose aspect; cells within the stroma below the surface are not pigmented, more or less elliptical, ca 7 µm diam with walls <1 µm thick. Perithecia are subglobose to elliptical in section, 240–270 µm high, 200–240 µm wide; the ostiolar canal is 75–100 µm long. The perithecial apex is not morphologically differentiated from the cells of the stroma surface. Cells of the interior of the stroma below the perithecia are pseudoparenchymatous, 7–12 µm diam with walls ca 1 µm thick, not pigmented. Asci are mostly clumped, and few asci were seen, these were 125–130 × ca 5 µm, the apex could not be clearly seen. Ascospores are bicellular, disarticulating while still in the ascus, green, spinulose, dimorphic;

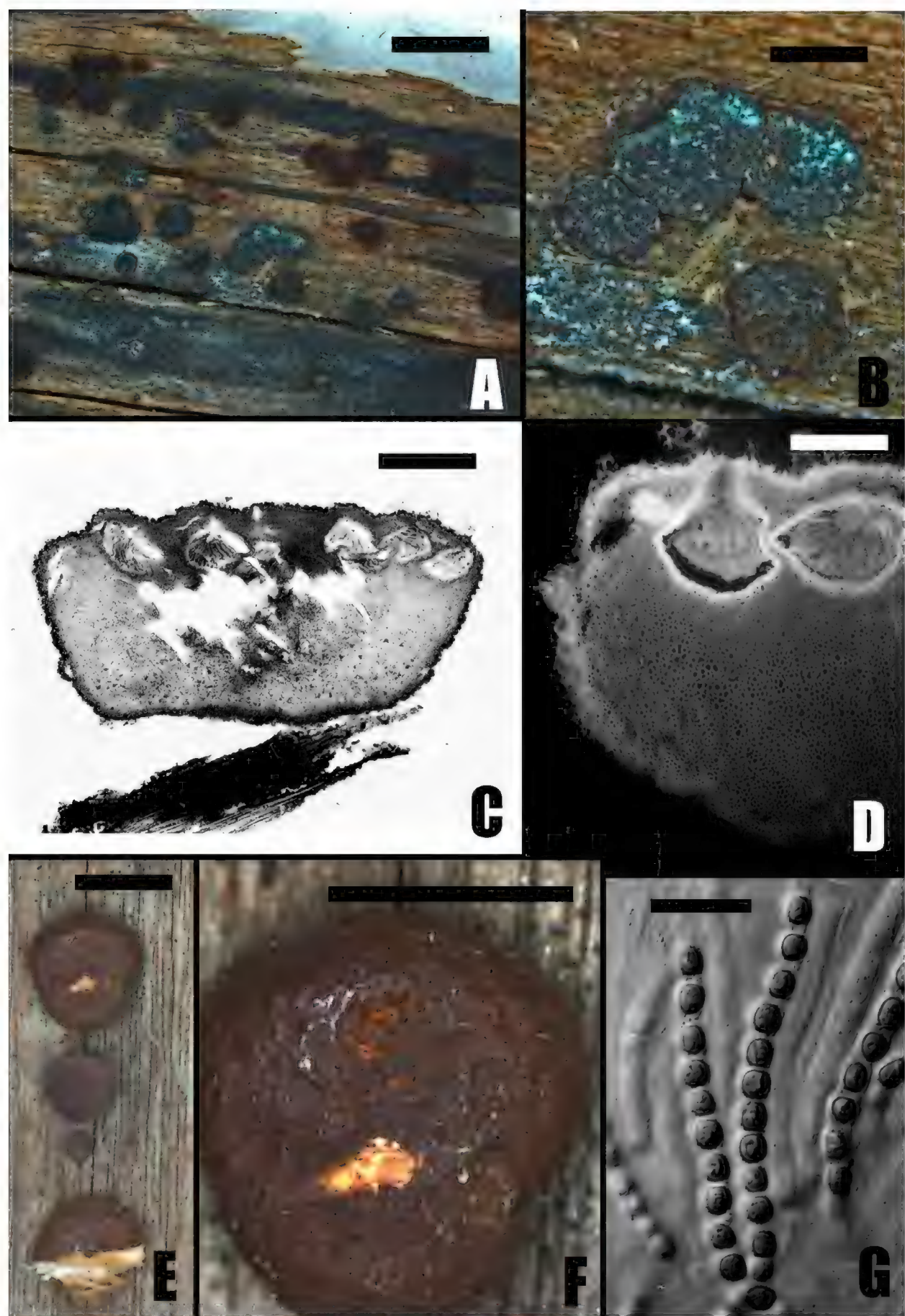


FIG 17. A–D. *Hypocrea rugulosa* A, B. Stromata. C, D. Sections through mature stromata showing perithecia and the ostiolar region (D). Type. E – G. *H. rugulosa* var. *major*. E, F. Stromata. G. Asci and ascospores. Taken from type, part ‘c.’ Scale bars: A, F, G = 2 mm, B = 1 mm, C = 0.5 mm, D = 200 μ m, E = 20 μ m, G = 10 μ m.

distal part subglobose, $5\text{--}6 \times 4.5\text{--}5.0 \mu\text{m}$; proximal part wedge-shaped to subglobose, $6.0\text{--}6.5 \times 4.5\text{--}5.0 \mu\text{m}$. No anamorph was observed.

Commentary: *Hypocrea rugulosa* is characterized by its gregarious, brown, rugose stromata and rather large green ascospores. The authors distinguished *H. rugulosa* var. *rugulosa* from var. *major*, the latter having larger but less rugose stromata and larger spores. I could not distinguish the type of var. *major* from the type of var. *rugulosa* and both varieties were described from Neilgherries by the same collector.

Hypocrea rugulosa Berk. & Cooke var. *major* Berk. & MC Cooke, in Cooke, Grevillea 12: 79. 1883. Fig. 17 E–G

= ? *Trichoderma rugulosum* (Berk. & Cooke) Samuels, Mycotaxon 137-4 (Supplement): 234. 2024.

Type: ‘c = *Hypocrea rugulosa* var. *major* B & Cke. *Hypocrea* Neilgherries [India] E.C.B.’ (K, Herb. Berk. 1879).

Description: The type collection consists of four pieces of wood glued to a piece of stiff paper and lettered ‘a –sterile [possibly in Cooke’s hand],’ ‘b,’ and ‘c.’

Part ‘a’ includes two of the four pieces of wood; this part was annotated in an unknown hand (Y. Doi?) as ‘Large spec. fertile Hyal. Spores.’ This is possibly *H. jecorina* Berk.

Part ‘b’ is an immature *Hypocrea* species that lacks ascospores.

Part ‘c’ is annotated by hand (Cooke?) as ‘c = *H. rugulosa* var. *major* B et Cke.’ has four stromata. One stroma has few perithecia seated on a broad, bulbous base; it may be immature and a different species from the other three stromata. The remaining three stromata are discoidal, 2–3 mm diam, 1 mm high, brown, rugose. These stromata are overmature and could not be sectioned; asci could not be measured nor could the ascus apex be discerned. Ascospores are bicellular, green, spinulose and disarticulating in the ascus. The part-ascospores are dimorphic; the distal parts globose to subglobose, $5\text{--}6 \times 4.5\text{--}5 \mu\text{m}$; the proximal parts are oblong to wedge-shaped, ovoidal or elliptic, $5.5\text{--}6.0 \times 4.5\text{--}5.0 \mu\text{m}$. No anamorph was seen.

Commentary: The herbarium sheet that includes the type of this variety was apparently originally prepared as simply ‘*Hypocrea* E.C.B.’ and filed in Berkeley’s collection. Most likely Cooke curated the collection and recognized that more than one species had been glued to the piece of paper. He marked the pieces as is noted above and clearly indicated that part ‘c’ was *H. rugulosa* var. *major*. The stromata on this piece of decorticated wood could not be distinguished from *H. rugulosa* var. *rugulosa*. Both varieties were described by Berkeley and Cooke from an ‘E.C.B.’ collection from Neilgherries in the same publication.

Hypocrea saccharina Berk. & M.A. Curtis, in Berkeley, J Linn Soc Bot 10: 376. 1868[1869] basionym non Racib. 1900. Fig. 18 A – E

≡ *Trichoderma saccharinum* (Berk. M.A. Curtis) Samuels, **comb. nov.** IF 901986.

Type: “805 *Hypocrea saccharina* B & C Cuba Wright (Curtis)” (K, Herb. Berk. 1879!) (apparently immature). Isotypes: “*Hypocrea saccharina* B & C Cuba Coll. Wright 752” (Lloyd 6101, BPI 717107!). (apparently immature). “Fungi Cubensis Wrightiani No. 752. *Hypocrea saccharina* B & C Coll: C. Wright (805)” (FH!) (mature spores present). LECTOTYPE hic designatus IF902307.

Description: The portion of *H. saccharina* in K consists of one piece of decorticated wood glued to a piece of stiff paper. Stromata are scattered, more or less discoidal, 0.5–1.0 mm diam, broadly attached to the substratum, yellow, appearing waxy, the surface is plane and perithecial papillae are not evident; there appear to be few perithecia in each stroma. The specimen appears to be immature and no microscopic preparation was made from it. An isotype in BPI (Lloyd 6101) comprises a small fragment of decorticated wood with a few scattered stromata that are morphologically similar to those on the lectotype and are also apparently immature; no microscopic preparation was made. A second isotype in FH, from the Wright collection, consists of two pieces of decorticated wood. Stromata are numerous, gregarious, discrete, discoidal, 1.0–2.5 mm diam, yellowish brown, broadly attached to the substratum with the margins almost perpendicular, at most slightly constricted at the base; most appear to be immature, younger stromata have a broad, sterile base. The surface of the stroma is plane and perithecial apices are not evident, ostiolar openings appear as dark areolae against the lighter background. Stroma surface is red in 3% KOH. The following description is based on the FH lectotype.

Cells of the stroma in surface view are circular to angular, 10–20 µm diam with walls 1.0–1.5 µm thick. There is no distinct surface region of the stroma; cells of the stroma surface in section are circular to angular, to 15 µm diam with walls 2 µm thick. The internal tissue below the perithecia comprises more or less nodose, thin-walled hyphae 7–10 µm wide. Perithecia are subglobose, 180–210 µm diam; the perithecial papilla lacks clavate elements and is not differentiated from the surrounding stromal tissue. Few asci were observed and only few mature ascospores were seen. Three asci measured were 105–115 × 7 µm; details of the ascal apex could not be discerned. Ascospores are green, bicellular but disarticulating into two part-ascospores in the ascus, thick walled (ca 1 µm), coarsely warted, the warts to 0.5 µm tall; the part ascospores are

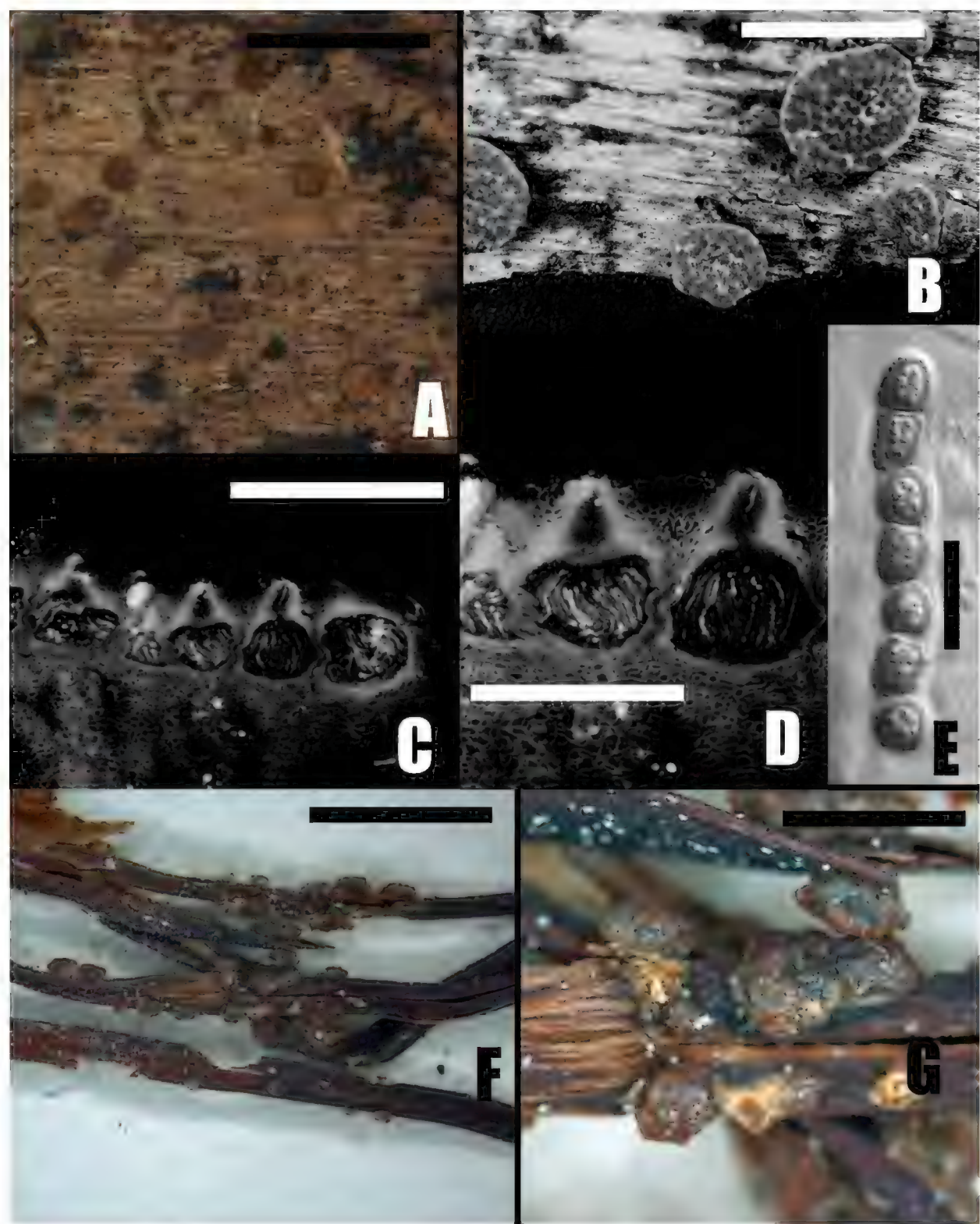


FIG 18. *Hypocrea saccharina*. A, B. Stromata.. B. *Wright 85*, isotype, FH. C, D. Section through stroma surface and perithecia. Isotype, *Wright 85*, FH. E. Ascospores. A. *Wright 85*, type, K; B – E. A. *Wright 85*, isotype, FH. F. *Hypocrea sacharina* var. *agricola*. Stroma. Type. Scale bars: A, B = 2 mm, C = 200 μ m, D = 100 μ m; E = 10 μ m; F = 5 mm.

monomorphic and broadly wedge-shaped or dimorphic, then the distal part subglobose to broadly conical, $(5-6-7(-8) \times (5-6-7 \mu\text{m})$ and the proximal part wedge-shaped, $6-7(-9) \times 5-6 \mu\text{m}$. No anamorph was observed.

Commentary: Cooke (1883) described spores of this species as being hyaline, but our study of type materials shows the spores to be green. Seaver (1910) said that the species was based on ‘imperfect material.’ Dingley (1957) said three collections in K identified as *H. saccharina* from New Zealand; two are immature and one is the type of *H. colensoi*. This species does not appear among the species included by Chaverri & Samuels (2003) in their revision of green-spored species of *Hypocrea* that included tropical species.

***Hypocrea saccharina* Berk. & M.A. Curtis var. *agaricicola* Berk. & C.E. Broome, J Linn Soc Bot 14: 111. 1875 [Dec 1873]. Fig. 18 F**

Type: “113. *Hypocrea saccharina*, B & C var. *agaricicola* Ceylon. G.H.T. Nov. 1867” (K, Herb. Berk. 1879!).

Description: The type specimen consists of two clumps of what appear to be marasmioid agarics with black stipes glued to a piece of stiff paper. Stromata are erumpent from the stipe, numerous and gregarious; they are discrete, 1–2 mm diam, tuberculate, the perithecial apices are visible as broad warts; stromata are broadly attached, appearing waxy, orange-yellow, more orange in 3% KOH but the lower part of the stroma is farinaceous; there appear to be few perithecia in each stroma. The cells at the surface of the stroma are angular, 10–12 μm diam and thin-walled. Crush mounts were made from two stromata but only very young asci were seen and none had developing ascospores.

Commentary: The type specimen is immature. Although the immature stromata strongly suggest that this is a species of *Trichoderma* and that it is quite distinct from *H. saccharina* var. *saccharina*. *Trichoderma stromaticum* Samuels & Pardo-Schultheiss, which obligately parasitizes the marasmioid species *Moniliophthora perniciosa* in America, is morphologically similar to this species (Samuels & al. 2012a). It is also possible that the ascospores will be bicellular, as in *Trichoderma* s. str., but not disarticulate into part-ascospores. *Hypocreopsis tingomariensis* Yoshim. Doi (Doi 1977) and *H. xylariicola* Samuels (Samuels 1988) are similar. Neither of these species is appropriately placed in *Hypocreopsis* Karsten and neither has been linked to an anamorph or subjected to phylogenetic analysis using DNA sequences.

The ultimate disposition of *Hypocrea saccharina* var. *agaricicola* must await further collections; it is certain that this represents a distinct species, but its generic placement remains in question.

Hypocrea scutelliformis Berk. & Ravenel [as '*scutellaeformis*'] Ellis & Everhart, North Am. Pyrenom. p. 80. 1892. (basionym) Fig. 19.

≡ *Trichoderma scutelliforme* (Berk. & Ravenel) Samuels, **comb. nov.**
IF 901702

Isotypes: "Ravenel. Fungi Caroliniani Exsiccati Fasc. 4, 31. *Hypocrea scutellaeformis* Berk. et Rav., sp. nov., ad corticem *Aceris rubri*," (NY, Ellis 'part of type'!. LECTOTYPE *hic designatus* IF 901703). "Ravenel. Fungi Caroliniani Exsiccati IV, 31. *Hypocrea scutellaeformis* Berk. et Rav., sp. nov., ad corticem *Aceris rubri*," (BPI, Ravenel bound set!).

Description: The NY part consists of a single piece of wood glued to a piece of stiff paper. The BPI part consists of 3 pieces of wood glued to the page of the exsiccate set. Stromata are numerous, discrete, tuberculate, 2–3 mm diam, centrally attached with margins slightly scalloped, surface smooth to wrinkled, perithecial apex not evident, reddish, copper, or reddish brown to purpureous, becoming olivaceous in 3% KOH; ostiolar openings not visible in the dry specimen but appearing as small, viscid dots when wetted with 3% KOH. Cells of the stroma surface in surface view pseudoparenchymatous, ca 7.5 µm diam with thick walls (1.5 µm); the walls with extracellular pigment deposits; the surface becomes reddish-brown in lactic acid. The specimens are over mature and the interior tissue is friable; there appear to be many enlarged cells. No asci remain. Part-ascospores discharged within the stroma hyaline, finely spinulose, dimorphic; globose to subglobose parts (3.0–)3.2–4.0 × 3.0–3.5(–4.0) µm; wedge-shaped to oblong, 3.5–4.5(–5.7) × 2.5–3.2(–4.0) µm. No anamorph seen.

Commentary: This species was issued as a new species, without description, in Ravenel, Fungi Caroliniani Fasc. 4 31. Two parts of this exsiccate were studied: BPI (Ravenel set) and NY (marked 'part of type and observations annotated in Ellis' hand. Both parts are overmature, lacking asci, but apparently the same species. The description given here is an amalgam of the NY and BPI specimens. Cooke (1884) synonymized *H. scutelliformis* and *H. ravenellii* Berk.

This is a distinctive species of *Trichoderma*. Cooke (1884) said that *H. ravenellii* 'B. in Raven. Fungi Car.' and *H. scutelliformis* 'B & C' are two names for the same species. We are not aware of any specimens of *H. scutelliformis* 'B & C.' *Hypocrea ravenellii* is a synonym of *Melogramma campylosporium*. Both species have a reddish coloration and tuberculate stromata, which could have lead Cooke to conclude that they were the same species. The only known specimens of *H. scutelliformis* are overmature but at least the NY part is filled

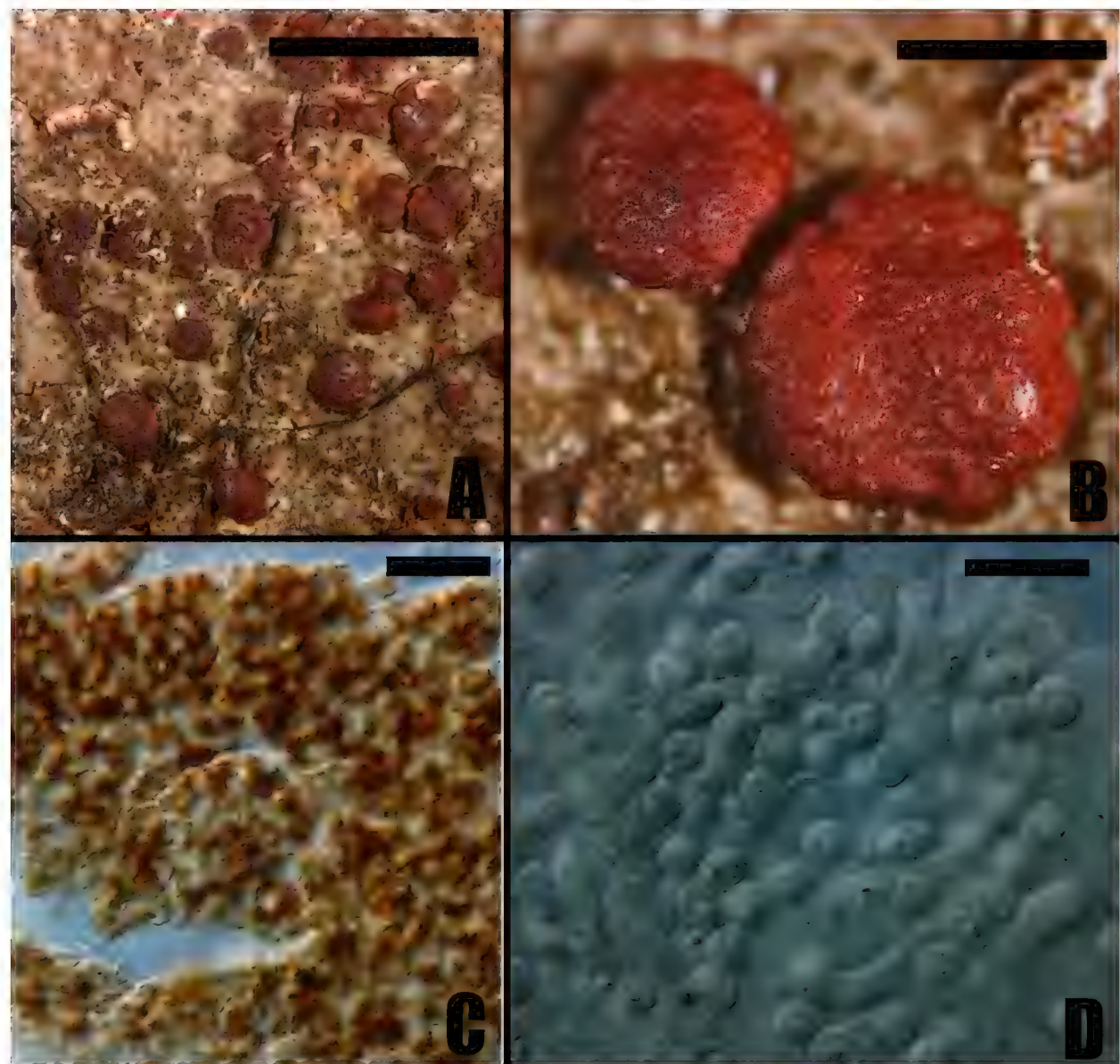


FIG 19. A–E. *Hypocrea scutellaeformis*. A, B. Stromata. C. Stroma surface. D. Part ascospores. “Ravenel. Fungi Caroliniani Exsiccati Fasc. 4, 31; NY, Ellis. Scale bars: A = 10 mm, B = 2 mm, C, D = 10 10 μ m.

with spores that appear to be the part-ascospores of a *Trichoderma* species; moreover, the ascospores of *M. campylosporum* are present in the type of *H. ravenelii* and are quite different from *Trichoderma* ascospores.

Hypocrea subrufa Berk. & Cooke in Cooke, Grevillea 12: 79. 1884 (basionym), non Henn. & Nyman 1899. Fig. 20

≡ *Trichoderma subrufum* (Berk. & Cooke) Samuels, **comb. nov.** IF 901704

Type: “No. 12 *Hypocrea subrufa* Berk. & Cooke, Neilgherries, ECB.” (K, Herb. Berk.!). LECTOTYPE *hic designatus*. IF 901705

Description: There are two specimens of *H. subrufa* in Berkeley’s collection, both seeming to be parts of a single gathering, both ‘No. 12,’ but one identified as ‘b = *Hypocrea subrufa* Berk. & Cooke’ without additional information while the other part is labeled “No. 12 *Hypocrea subrufa* Berk. & Cooke, Neilgherries, ECB.” It is this second part that is designated here as lectotype.

The part labeled ‘b’ comprises two pieces of corticated wood glued to a piece of paper. There are two stromata on one piece and a single stroma on the other piece. The stromata are discrete, discoidal, circular in outline, 1.5–2.0 mm diam, yellowish brown, with red coloration in 3% KOH, and have free margins; the surface is plane; the ostiolar openings appear as numerous brown dots. This specimen is immature; neither asci nor ascospores were seen.

The other part, designated here as lectotype, not lettered separately, also consists of two pieces of a corticated twig measuring ca 10 mm diam glued to a piece of paper. Numerous stromata are present, they are discrete, more or less discoidal, circular in outline, 0.5–1.5 mm diam, ca 0.5 mm high, yellowish brown with red coloration in 3% KOH, margins free; the surface is plane and the ostiolar openings appear as numerous, low tubercles. Cells of the stroma surface in face view are circular to angular in outline, 7–15 µm diam, with walls 1.0–1.5 µm thick. In section the surface region of the stroma is 15–20 µm thick and composed of circular to angular cells ca 7 µm diam with walls 1.0–1.5 µm thick; in lactic acid these cells are yellow. Immediately below the surface region and between the perithecia cells are thin-walled and angular or nearly hyphal and non pigmented. Perithecia are crowded, elliptic in section, 200–225 µm high, 130–150 µm wide; the ostiolar canal is ca 100 µm long; the ostiolar region of the perithecium is formed of small, thin-walled cells that are not anatomically distinct from the cells of the surrounding stroma surface; there are no clavate or hyphal elements in the ostiolar region. The tissue below the perithecia comprises circular to irregularly shaped, 7–15 µm diam, thin-walled, cells. Asci are cylindrical, 60–80 × 4.0–4.5 µm; the apex appears to lack a ring. Ascospores are bicellular, hyaline, smooth or becoming finely spinulose, disarticulating into two monomorphic and globose or subglobose, or dimorphic, part-ascospores while in the ascus; distal part-ascospores globose

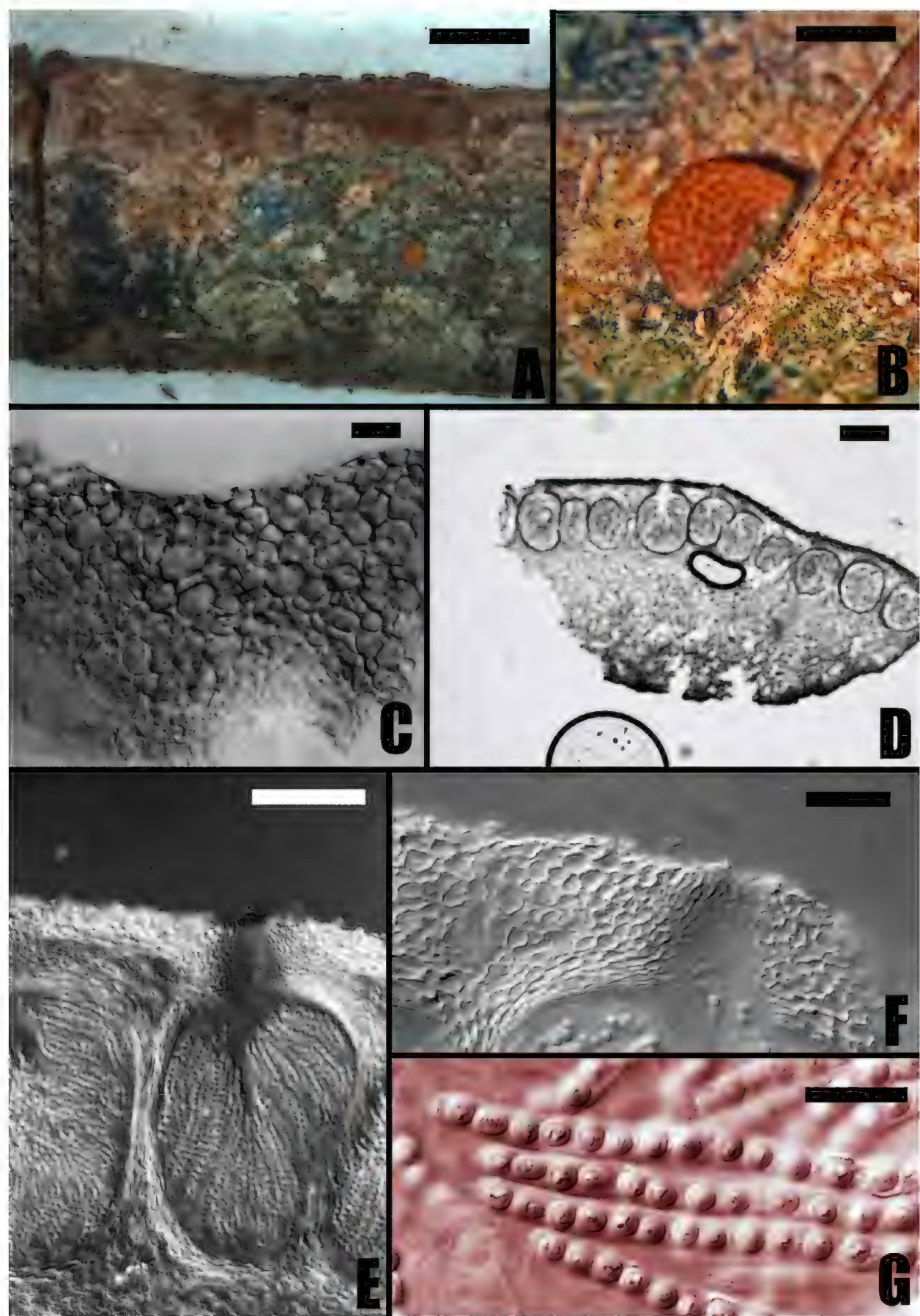


FIG 20. A–G. *Hypocrea subrufa*. A, B. Stromata. C. Stroma surface. D. Median longitudinal section through a stroma. E. Median longitudinal section through a perithecium. F. Section showing stroma surface and ostiolar area. G. Asci and ascospores. “No. 12 *Hypocrea subrufa* Berk. & Cooke, Neilgherries, ECB.” Scale bars: A = 5 mm, B = 1 mm, C = 20 µm; D, E = 100 µm, F = 50 µm, G = 10 µm.

to subglobose, $3.0\text{--}3.5 \times 2.7\text{--}3.2 \mu\text{m}$; proximal part globose to subglobose, ovoidal, oblong or wedge-shaped, $(3.0\text{--})3.5\text{--}4.0 \times 2.5\text{--}3.0 \mu\text{m}$. No anamorph was observed.

Commentary: The protologue does not mention a part labeled ‘b,’ but specimen ‘No. 12’ is divided into two parts, one mature and the other (b) immature. It is not at all clear that these two parts represent a single species. The differences in stroma color and in the appearance of the ostiolar openings suggest that they are different; moreover, the fact that one part has mature stromata while stromata of the other part are immature argues that at least they are not part of a single population. I take the mature part to be the lectotype of *H. subrufa*.

Samuels *et al.* (2012b) reported but did not name a *Hypocrea* teleomorph for *T. pinnatum* Samuels from Sri Lanka. This teleomorph is very similar to *H. subrufa*, the main difference being that part-ascospores in this single collection of *T. pinnatum* are strictly monomorphic.

Hypocrea subrufa Henn. & Nyman (in Hennings in Warburg, *Monsunia* 1: 163. 1899 [1900]), a later homonym, was renamed as *H. nymani* Henn. Its identity is not known.

Hypocrea subviridis Berk. & M.A. Curtis, in Berkeley, *Grevillea* 4: 15. 1875.

= ? ***Clonostachys epichloe*** Schroers, *Stud. Mycol.* 46: 140. 2001.

≡ *Nectria epichloë* Speg., *Anal. Soc. Cient. Argent.* 19(1): 39. 1885.

≡ *Nectriopsis epichloe* (Speg.) Samuels, *Mem. New York Bot. Gard.* 48: 69. 1988.

≡ *Bionectria epichloe* (Speg.) Schroers, *Stud. Mycol.* 46: 140. 2001.

Type: “*Hypocrea subviridis* Berk. & Curt., 4955. Car. Inf.” [K(m): 58325!].
HOLOTYPE

Description: The type specimen consists of two pieces of grass glued to a piece of paper. Perithecia are densely gregarious, seated in a white subiculum and overgrowing rust pycnia, pyriform, *ca* 174 μm diam, with an acute apex, smooth, thin-walled, collapsing by lateral pinching, not reacting to 3% KOH. Neither asci nor ascospores were seen. A sporodochial, phialidic anamorph with pale green conidia forms in the subiculum.

Commentary: The type specimen is overmature and many of the perithecia are broken. After four attempts neither asci nor ascospores were found. This is very similar to *Clonostachys epichloe* (Samuels, 1988, as *Nectriopsis* Schroers, 2001), which occurs on stromata of *Balansia* and *Epichloe* species on grass culms and may be the same.

Hypocrea tomentosa Berk., in Hooker, *Bot. Antarct. Voy.*, III, Fl. Tasman. 2: 278. 1859 ["1860"]. Fig. 21 A – E

≡ *Hypomyces tomentosus* (Berk.) Berk., *Grevillea* 4: 15. 1875.

=? *Protocrea farinosa* (Berk. & Broome) Petch, *J. Bot.* 75: 219. 1937. (fide Jaklitsch & al. 2008).

Type: "*Hypocrea tomentosa*, Fr., Tasmania, Fl. Tasman 2: 273. 1860" (K, Herb. Berk. 1879!). HOLOTYPE

Description: The type specimen consists of a piece of polypore glued to a piece of stiff card, and several fragments in a glassine bag. The pore surface has a granular white mycelium on which are crowded many off-white perithecia that are largely free of mycelium. There is no color change in 3% KOH (the perithecial wall becomes pale luteous or somewhat more orange). Hyphae of subiculum are straight, smooth, not swollen, ca 3 µm wide, thin-walled. No anamorph is visible. Perithecia have become cupulate and have a small papilla sitting in the middle of the cup, when rehydrated they are subglobose, 350–375 µm diam and have a minute apical papilla. Perithecia are easily removed from the subiculum; the surface of perithecial wall, in face view, is formed of intertwined hyphae; the lateral wall of the perithecium, when viewed in a crush mount, is ca. 15 µm wide and formed of at most 5 layers of elliptic to fusoid, ca 5 × 2 µm cells; the papilla lacks thick-walled or clavate elements; it appears to be formed of small, indistinct cells. Asci are cylindrical, 55–72 × (3.2–)3.7–5.2 µm; the apex is slightly thickened with a ring; ascospores are uniseriate. Ascospores are hyaline, finely spinulose and bicellular but disarticulate into 16 part-ascospores in the ascus; part ascospores are dimorphic. The distal part-ascospores subglobose, (2.5–) 3.0–4.0(–4.5) × (2.2–)2.5–3.2(–3.7) µm; the proximal part-ascospores, wedge-shaped, (3.0–)3.2–4.0(–4.5) × (1.7–)2.0–2.5(–4.0) µm. Some minute, unicellular, oblong conidia are present on the specimen; these could be from a *Gliocladium* but conidiophores were not seen.

Commentary: There is uncertainty concerning the correct application of this name. Berkeley used the name in two senses. The type collection, described above, has hypocrea-like, disarticulating bicellular ascospores; it was collected on a polypore in Tasmania by William Archer. However, in 1875 Berkeley listed "*Hypomyces tomentosus*. Fr. – on some Agaric. No. 6189" in his *Notices of North American Fungi*. This second collection in Berkeley's herbarium (K) bears the label: "6189. *Hypocrea tomentosa* Fr.," with the annotation in unknown hand "from N. America, *Grevillea* 4: 15, a true *Hypomyces* [with a drawing of a 2-celled, apiculate, verrucose spore typical of *Hypomyces*]." This specimen is half an agaric, glued to a card, showing a deformed gill surface

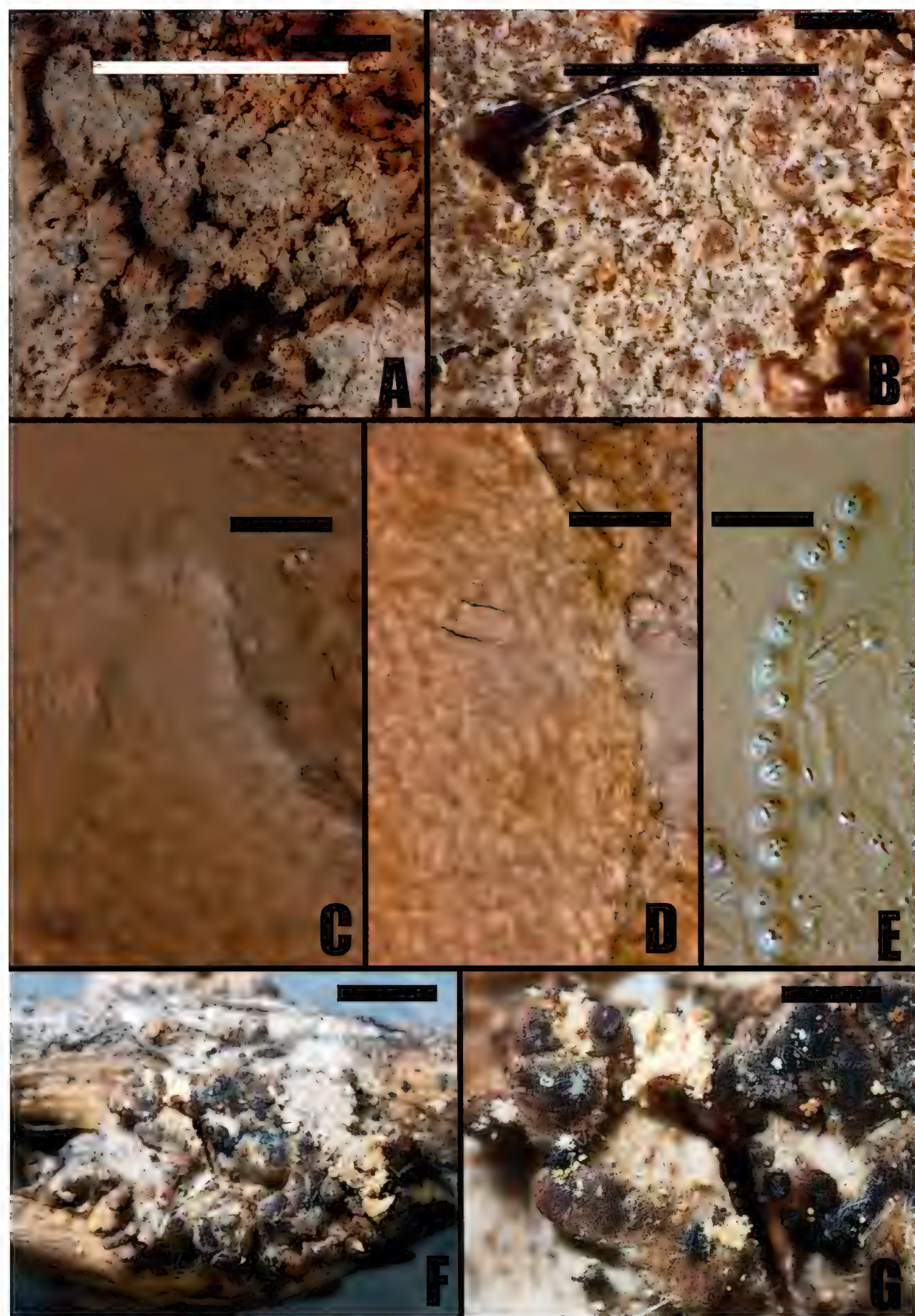


FIG 21. A–E. *Hypocrea tomentosa*. A, B. A piece of polypore glued to stiff paper; B showing outlines of perithecial elevations. C. Perithecial papilla and stroma surface. D. Optical section of a perithecium showing the wall. Ascospores in an ascus. Type. Scale bars: A = 5 mm. B = 2 mm; C, D = 50 μ m. E = 10 μ m. F, G. *Hypocrea tuberiformis*, stroma. Ravenel, Fungi americani 733. Scale bars: F = 1 mm, G = 2 mm.

covered by an ochraceous subiculum with amber colored perithecia that do not react to 3% KOH. Clark T. Rogerson annotated the specimen in 1960: "note. Specimen in Curtis herbarium (FH) gives collecting data: M.A. Curtis 6189, on *Lactarius* ? Society Hill, South Carolina, Aug. 1856." Rogerson identified it as *Hypom. banningiae* and, in 1973 Günter Arnold annotated the specimen as "*Hypom. macrosporus*. Berkeley (1875)." Cooke (1884) furnished the first description of asci and ascospores for "*Hypom. tomentosus* Fries."

Jaklitsch & al. (2008) placed *Hypocrea tomentosa* and *H. nebulosa* Massee, also from a polypore collected in Tasmania, in possible synonymy of European *Protocrea farinosa* (Berk. & Broome) Petch pending the sequencing of additional collections from Tasmania.

Hypocrea tuberiformis Berk. & Ravenel, in Berkeley, Grevillea 4: 13. Sep 1875. Fig. 21 F, G

≡ *Dussiella tuberiformis* (Berk. & Ravenel) Pat. ex Sacc., Syll. Fung. (Abellini) 9: 1004. 1891.

≡ *Hypocrella tuberiformis* (Berk. & Rav.) G.F. Atk., Bot Gaz 16: 284. 1891.

≡ *Echinodothis tuberiformis* (Berk. & Rav.) G.F. Atk., Bull Torrey Club 21: 224. 1894. (*fide* Atkinson, 1894).

Type: Ravenel, Fungi Caroliniani No. 1220. Isotypes (?): Ravenel, Fungi Caroliniani No. 52; Ravenel, North American Fungi No. 733. Type: "*Hypocrea tuberiformis* Berk. & Ravenel, on culms of *Arundinaria*, Seaboard, SC, Mai '81, H.W. Ravenel" (NY 01179828!). Handwritten label. Isotype?

Commentary: There are two specimens in the Ellis collection (NY); one is Ravenel's North American Fungi 733 and the other, marked 'type,' has the handwritten label indicated above. I did not examine these collections microscopically. Material from Berkeley's herbarium was not examined for this study, nor was Ravenel's Fungi Caroliniani No. 1220. Atkinson (1891) provided a complete review of taxonomy, morphology and biology of the species to that time based on the specimens cited here as well as his own collections. According to Atkinson (1891) the Ravenel collections are sterile but he found the species on *Arundinaria macrosperma* var. *suffruticosa* around Auburn, Alabama. He described an obviously clavicipitaceous fungus for which he later described the genus *Echinodothis* Atk. (Atkinson 1894).

Hypocrea typhina (Pers.) Berk., Outl. Brit. Fung.: 383. 1860.

≡ *Sphaeria typhina* Pers., Icon. Desc. Fung. Min. Cognit. 1: 21. 1798.

≡ *Epichloe typhina* (Pers.) Brockm., Arch. Ver. Freunde NatGesch. Mecklenb. 17: 242. 1863.

≡ *Epichloe typhina* (Pers.) Tul. & C. Tul., Select. Fung. Carpol. 3: 24. 1865.

= *Hypocrea undulata* Berk. & M.C. Cooke, in Cooke, Grevillea 12: 79. 1884. Fig. 22

≡ *Hypocreopsis undulata* (Berk. & Cooke) Sacc., Syll. Fung. 9: 981. 1891.

= *Stilbocrea macrostoma* (Berk. & M.A. Curtis) Höhn, Sitzungsber. Kaiserl. Akad. Wiss., Math.–Naturwiss. Cl. Abt. 1, 118: 1185. 1909.

≡ *Nectria macrostoma* Berk. & M.A. Curtis in Berkeley, J. Linn. Soc. Bot. 10: 378. 1869.

Type: “*Hypocrea undulata* B & Cke., [60], [India] Neilgherries, ECB” (K, herb. Berk. 1879!). HOLOTYPE

Description: The type specimen consists of several fragments of bark glued to a piece of paper. Stromata form an extensive subcortical pad and are erumpent through the bark; on the surface of the bark stromata are indefinitely effused, tan with nearly black ostiolar areas, furfuraceous, perithecia completely immersed with only the papilla protruding, not reacting to 3% KOH. The stroma surface is formed of loosely intertwined, ca 2 µm wide, smooth, frequently septate hyphae; within the stroma the hyphae are more compact, frequently branched, 4–5 µm wide. Perithecia are elliptical in section, 350–425 µm high, (175–)225–280 µm wide; the perithecial wall is 15–25 µm wide, formed of intertwined hyphae with walls ca 1.5 µm thick; the perithecial papilla is formed of chains of small, vertically elongated cells, the terminal cells of which are papillate and thick-walled; cells of the papilla merge with the hyphae of the surrounding stroma. Asci are cylindrical, 100–115 × 8–10 µm, sessile, 8-spored, spores uniseriate with overlapping ends; the apex could not be seen clearly but appears to be simple. Ascospores are ellipsoidal to fusiform, (11.0–)12.7–16.2(–20.0) × (5.0–)5.5–6.0 µm, remaining bicellular in asci, hyaline, rugose. A few robust, white synnemata arise from the stroma surface.

Commentary: The type specimen of *H. undulata* fits well into the concept of *Stilbocrea macrostoma* in Rossman & al. (1999), the teleomorph of *Stilbella aleuriata* (Berk. & M.A. Curtis) Seifert.

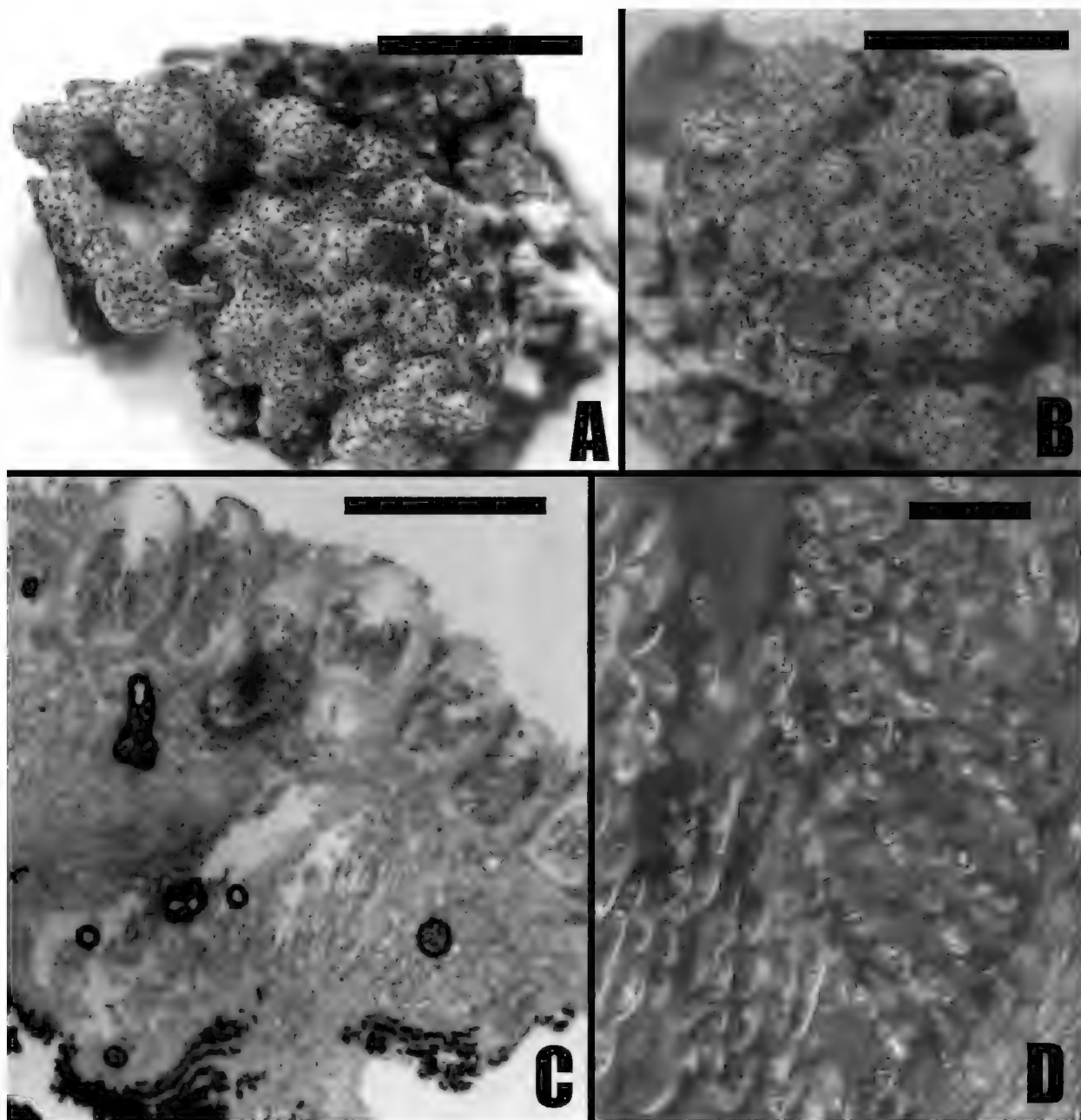


FIG 22. A–D. *Hypocrea undulata*. A, B. Stroma. C. Median longitudinal section through perithecia. D. Asci and ascospores. Type. Scale bars: A = 5 mm, B = 2 mm, C = 500 μ m. D = 20 μ m.

Hypocrea viridans Berk. & M.A. Curtis, in Berkeley, J. Linn. Soc. Bot. 10: 376. 1868.

≡ *Clintoniella viridans* (Berk. & M.A. Curtis) Sacc. & P. Syd, in Saccardo, Syll. Fung. 16: 588. 1902.

≡ *Aschersonia viridans* (Berk. & M.A. Curtis) Pat., Bull. Soc. Mycol. France 7: 48. 1891.

≡ ***Hypocrella viridans*** (Berk. & M.A. Curtis) Petch, Ann. Roy. Bot. Gard. Peradeniya 7: 236. 1921.

≡ *Underwoodina viridans* (Berk. & M.A. Curtis) Kuntze, Revis. Gen. Pl. 3(3): 538. 1898.

= *Hypocrella glaziovii* Henn., Engler's Bot. Jahrb. 17: 524. 1893 fide Chaverri & al., 2008.

= *Aschersonia brunnea* Petch, Ann. Roy. Bot. Gard. Peradeniya 7: 251. 1921 fide Chaverri & al., 2008.

Type: "450 *Hypocrea viridans*, B & C, Cuba. C. Wright" [annotation in pencil by unknown person "*Aschersonia viridians* (B & C) Pat."] (K, Herb. Berk.). HOLOTYPE

Epitype (*fide* Chaverri *et al.* 2008): Mexico: *Guerrero*: Cuajimicuilapa, on leaf and rachis of *Mimosa pigra*, 30 Nov. 1989, H.C. Evans (I89–490). (IMI 346739 = culture ARSEF 7674).

Description: The holotype specimen consists of a fragment of a leaf of a dicotyledonous plant glued to a piece of paper. Stromata are scattered, pulvinate, *ca* 1.5 mm diam, 0.75 mm high, gray-green; fruit bodies are barely visible as low, broad warts each having a small ostiolar opening in the middle. I did not make a microscopic preparation from the specimen.

Commentary: Patouillard & Lagerheim (1891) found this specimen to be asexual only and Patouillard transferred the name as *Aschersonia viridans*. Chaverri & al. (2008) confirmed that the type is asexual only and epitypified the name with a perithecial collection. They listed *Hypocrella glaziovii* Henn. In synonymy and gave *Aschersonia brunnea* Petch in synonymy of *A. viridans*. *Hypocrella viridans* is common as its anamorph on white flies and scale insects in the American tropics (Chaverri & al. 2008).

Hypocrea viridirufa Berk. & Ravenel, in Berkeley, Grevillea 4: 14. 1875.

≡ *Hypoxylon viridirufum* (Berk. & Ravenel) Cooke, Grevillea 11: 129. 1883.

≡ ***Penzigia viridirufa*** (Berk. & Ravenel) J.H. Miller, Monogr. World Spec. *Hypoxylon*: 142. 1961.

Type: "[printed label] H.W. Ravenel, Herbarium – Recd. 1891." "[hand written label] *Hypocrea viridi-rufa* B & R, in *Alnus serrulata*, Santee Canal,

SC, HWR, [with a date? 1846],” [annotated: spores brown, .0004 inch long] (K)!. HOLOTYPE

Description: The type specimen is in poor condition and was not mounted. It includes a hypoxylon-*like* stroma. The specimen label is annotated in ink by an unknown person “spores brown, .0004 inch long” and there is an ink drawing of 5 ellipsoidal, unicellular, colorless spores, each with a single large circle in the middle.

Commentary: Ju & Rogers (1996) considered *H. viridirufa* to be a later name for *Hypoxylon xanthocreas* Berk. & M.A. Curtis, which they excluded from *Hypoxylon* as a penzigoid *Xylaria*.

Hypocrea vitalbae Berk. & Broome, Ann. Mag. Nat. Hist. Ser. 3, 3: 362. 1859.

≡ *Broomella vitalbae* (Berk. & Broome) Sacc., Syll. Fung. 2: 557. 1883.

Commentary: The type of *H. vitalbae* was not examined for this work. The excellent illustrations in the protologue leave no doubt that this is not a species of *Trichoderma*. Shoemaker & Müller (1963) redescribed this species, and named its anamorph, *Pestalotia vitalbae* Shoemaker & E. Müll. (≡ *Truncatella vitalbae* (Shoemaker & E. Müll.) Shoemaker & al. 1989.)

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